Computer Graphics

Introduction

Computer graphics can be defined as the creation and manipulation of graphic image by means of computer. Computer graphic started as a technique to enhance the display of information generated by a computer. This ability to interpret and represent numerical data in pictures has significantly increased the computer's ability to represent information to the user in a clear and understandable form. Large amounts of data are rapidly converted into bar charts, pie charts, and graphs. Graphics displays have also improved our understanding of complex system such as molecular biology; reaffirming the saying that one picture is worth a thousand words.

Display Screens

Display screens are output devices that show programming instructions and data as they are being and information after it is processed, display screens are either CRT (Cathode-Ray-Tube) or flat-panel display.

CRT Displays: use vacuum tube like that in a TV set.

Flat-panel displays: are thinner, weightless, and consume less power than CRT displays but are not as clear. Principal flat-panel displays are liquid-crystal displays (LCD) and gas-plasma display.

The size of screen is measured diagonally from corner to corner in inches.

The Cathode Ray Tube (CRT) Display:

The CRT display screens consist of three components:

1- Cathode Ray Tube (CRT).
2- Frame buffer.
3- Display controller.

Cathode Ray Tube (CRT):

Consists of electron gun that contains a cathode that when heated emits a beam of negatively charged electrons towards a positively charged phosphor coated screen. The electron beam passes through the focusing and deflection system, which consist of an electrostatic or magnetic field. A color CRT has three electron guns, one for each of three primary colors: red, green, and blue.

The focusing system concentrates the beam so that by the time the electrons reach the screen, they have converted to small dot. The deflection system, which consists of two pairs of deflection plates (horizontal and vertical) directs the electron beam to any point on the screen.

When the electron beam strikes the screen, the phosphor emits a spot of visible light that intensity depends on the number of electrons on the beam. The duration of this light, called persistence, depends on the type of phosphor that coats the screen. In order to give the viewer the appearance of continuous flicker-free image, each dot on the screen must be intensified many times per second. This type of CRT is called a refresh CRT. Two types of refresh CRTs are available: raster-scan and random vector.

Frame Buffer:

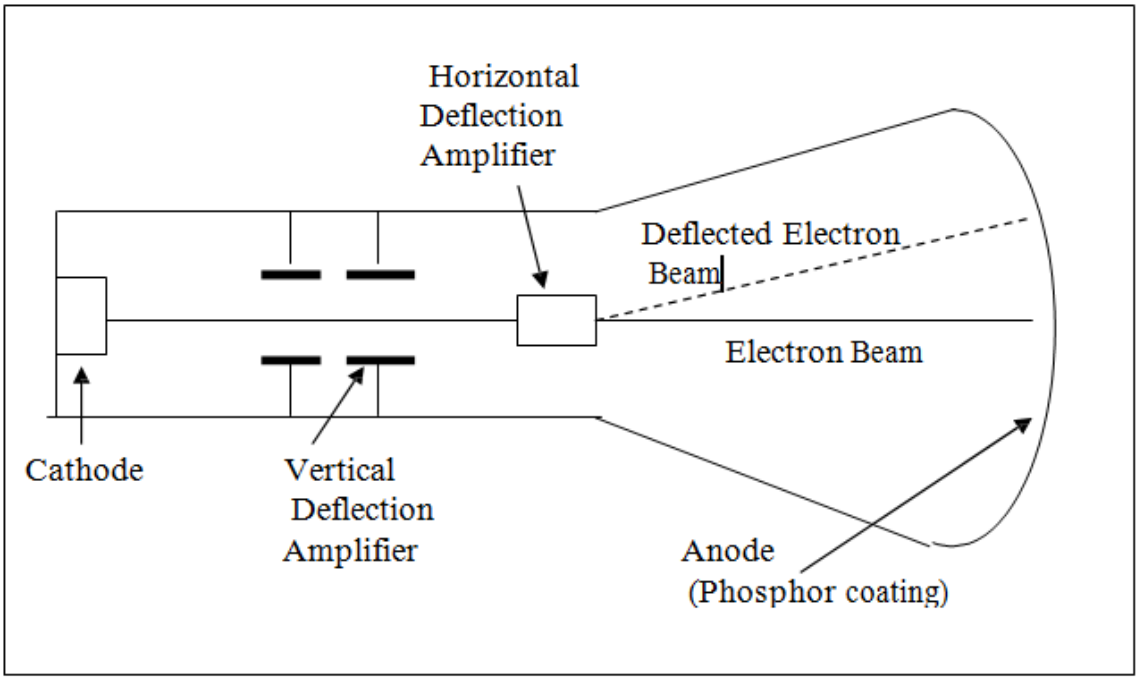
Each screen pixel corresponds to a particular entry in a two dimensional array residing in memory. This memory is called a frame buffer or a bit map. The number of rows in the frame buffer array equals the number of raster lines on the display screen. The number of columns in this array equals the number of pixels on each raster line.

The term pixel (picture element) is also used to describe the row and column location in the frame buffer arrays that corresponds to the screen location. A 512×512 display screen requires 262,144 pixel memory location. Whenever we wish to display a pixel on the screen, a specific value is placed into the corresponding memory location in the frame buffer array. Each screen location pixel and corresponding memory location in the frame buffer is accessed by an (X,Y) integer coordinate pair. The x value refers to the columns, the y value to the row position.

Each pixel in the frame buffer array is composed of a number of bits. A black and white image that has only two intensity levels, on-off, has single bit plane frame buffer. In order to display a color or a black and white quality image with shades of gray, additional bit planes are needed.

Display Controller:

The hardware device that read the contents of the frame buffer into video buffer, which then converts the digital representation of a string of pixel values into analogue voltage signals that are sent serially to the video display screen (CRT).



The Flat Panel Display:

Compared to CRT displays, flat panel displays are much thinner, weightless, and consuming less power. Thus they are better for portable computers. Flat panel displays are made up of two plates of glass with a substance between them, which is activating in different ways. Flat panel displays are distinguished in two ways:

1- By the substance between the plates of glass.

2- By the arrangement of the transistors in the screens.

Two common types of technology used in flat panel display screens are:

a\ Liquid Crystal display (LCD):

It consists of a substance called liquid crystal, the molecules of which line up in a way that alter their optical properties. As a

result, light usually backlighting behind the screen is blocked or allowed through to create an image.

b\ Gas Plasma Display:

It is like a neon bulb, in which the display uses a gas that emits light in the presence of an electric current. That is, the technology uses neon gas and electrodes above and below the gas. When electric current passes between the electrodes, the gas glows. Although gas plasma technology has better resolution than LCD technology, it is more expensive and thus is not used as often as a LCD. On the other hand, LCDs are not practical for screens larger than 20 inches and so are not practical for TV size screen.

Video Display Card:

To display graphics, a display screen must have a video display adapter. A video display adapter also called a graphics adapter card, which is a circuit board that determines the resolution, number of colors, and how fast images appear on the display screen. Video display adapter come with their own memory chips, which determine how the card process the image and how many colors it can display. A video display adapter with 256 kb of memory will provide 16 colors; one with megabyte will support 16.7 million colors.

The video display adapter is often built into the motherboard although it may also be an expensive card that plugs into an expensive slot.

Monitor Type	Remarks
EGA (Enhanced Graphics Array)	Support 16 colors in 640-by-350 pixel resolution introduced by IBM in 1984.superseded CGA
VGA (Video Graphics Array)	Displays 16 colors in 640-by-480 pixel resolution and 256 colors at 320 by 200 pixels. This color bitmapped graphics display standard was introduced in 1987 for IBM PS/2 computers
SVGA (Super Graphics Array)	Supports 256 colors with 800 by 600 pixel resolution and a 1024 by 768 resolutions. This is a higher version of VGA.
XGA (Extended Graphics Array)	Displays up to 16,777,216 colors at resolutions up to 1024 by 768 pixels.

Screen Clarity:

The screen clarity depends on three qualities:

1- Resolution:

The clarity or sharpness of display screen is called resolution. The more pixels per square inch, and the better of resolution. Resolution is expressed in terms of the formula (horizontal pixels×vertical pixels). Each pixel can be assigned a color or particular shade of gray. A screen with 640×480 pixels multiplied together equals 307200 pixels. This screen will be less clear and sharp

than a screen with 800×600 (equals 480000) 0r 1024×768 (equals 786432) pixels.

2- Dot Pitch:

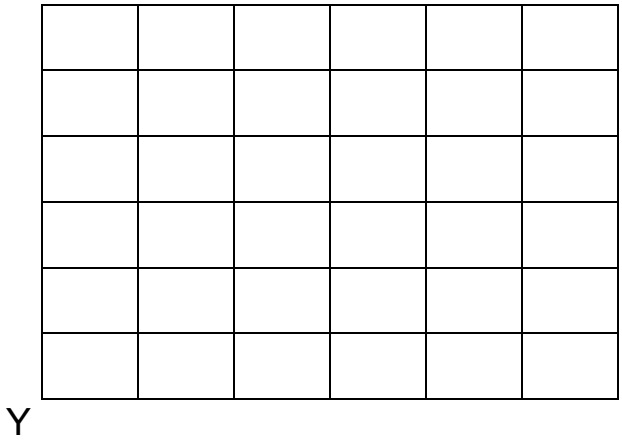
It is the amount of space between the center of adjacent pixels, the closer the dots, the crisper the image. For crisp images, dot pitch should be less than 0.31 millimeter.

3- Refresh Rate:

It is the number of times per second that the pixels are recharged so that their glow remains bright. In general, displays are refreshed 45 to 100 times per second.

Graphics versus text:

Compare with the graphic mode, the PC's text mode is easy to use. Displaying information on the screen is a simple as placing ASCII char in specific memory location. The text screen is divided into 80 column and 25 rows. The graphic mode requires a completely different orientation instead of character; you have pixels, the smallest picture element on your computer display. Today most screens can display text and graphics.



To draw a point on the display screen, a point plotting procedure is required. We assume the availability of the command: Putpixel (x , y , color).

The drawing on the screen starts from top to down, and from left to right. The pixel coordinates on the screen (VGA 640×480) is shown in figure below: