Graphics

The word graphics is associated with charts, graphs, images, pictures and patterns. Computer graphics involves the computer with the visual forms. It is the interface of graphical communications with computer technology.

Today we find computer graphics used in many fields such as sciences, art, engineering, business, industry, medicine, government, entertainment, education training and home applications.

Graphics create:

- Drawings
- Charts
- Multi font text
- Anything that can be drawn

- A major use of computer graphics is in design processes particularly for engineering and architectural systems. Generally referred to as CAD (**C**omputer-**A**ided **D**esign).
- Some designed objects are first displayed in a wire-Frame outline (shows the overall shape and internal features of the objects). Wire-frame allow designers to quickly see the effects of interactive adjustments to design shapes without waiting for object surface to fully generated.
- **Virtual – Reality Environments**
  One of today application of computer graphics is in the creation of virtual-Reality environment in which a user can interact with the objects in a three-dimensioned scene. Specialized hardware devices provide three – dimensioned viewing effects and allow the user to pick up objects in a scene.
- **Data visualizations**
  Producing graphical representations for scientific, engineering and medical data sets and processes is another new application of computer graphics. Researchers, analysts and others deal with large amounts of information or to study the behavior of complex processes. Data is converted to a visual form. If we plot density values we can easily see the overall pattern of the data.

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- **Entertainment**
  Television is a productions motion pictures and music videos routinely use computer graphics methods. Graphics images may be combined with live actors and scenes and sometimes the films completely generated using computer- rendering and animation techniques.

- **Image processing**
  Modification or interpretation of existing pictures such as photographs and TV scans is called image processing. Methods used in computer graphics and image processing overlap. The two areas are concerned with fundamentally different operations. In computer graphics a computer is used to create a picture. Image processing techniques are used to improve picture quality.

  > Image processing methods are often used in computer graphics and computer graphics methods are frequently applied in image processing

GUI (Graphical User Interfaces)

A graphical interface is a window manager that allows a user to display multiple rectangular screen areas called display windows. Each screen display area can contain a different process showing graphical or no graphical information and various methods can be used to activate a display window.

Raster – scan Display

Picture definition is stored in a memory area called the refresh buffer or **frame buffer**. The term frame refers to the total screen area. This memory area holds the set of color values for the screen points. These stored color 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.

In this way the picture is painted on the screen one scan line at a time. Each spot is referred to as a **Pixel (Picture element).**

Raster scan systems are characterized by their resolution which is the number of pixel positions that can be plotted.

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Raster- scan systems

Several processing units are used in the interactive raster-graphics systems. 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.
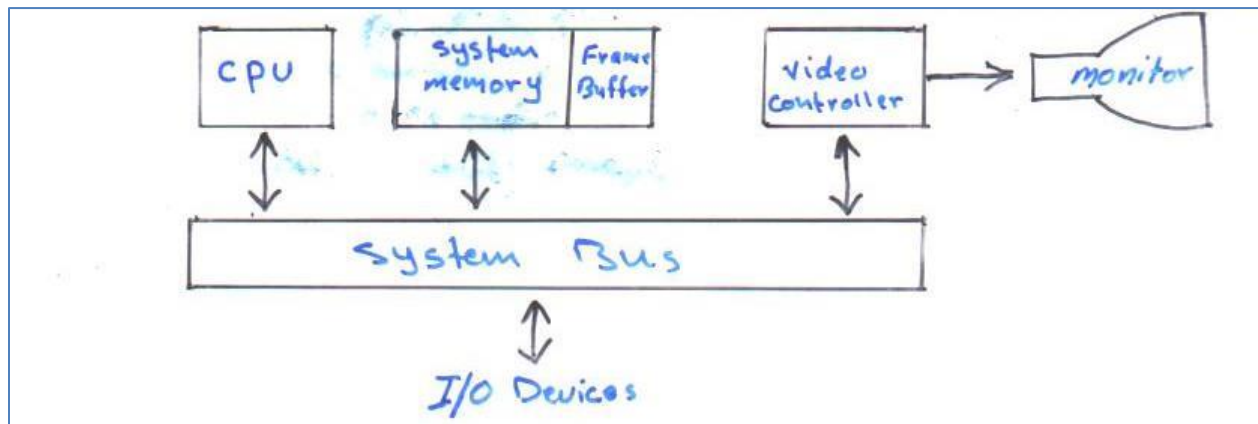
*Architecture of simple raster-graphics system*

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 **Bit Map**. Frame Buffer accessible to the central processing unit (CPU) of the main computer this allowing rapid update of the stored image.

Numbers of rows in the frame buffer array equals the number of raster lines on the display screen. Number of columns in this array equals the number of pixels on each raster line.

The term pixel is also to describe the row and column location in the frame buffer array that corresponds to the screen location. A 512 x 512 display screen requires 262144pixels memory locations.

If 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 pixel in the frame buffer array is composed of a number of bits. A single bit plane frame buffer in order to display a color or black and white quality image.
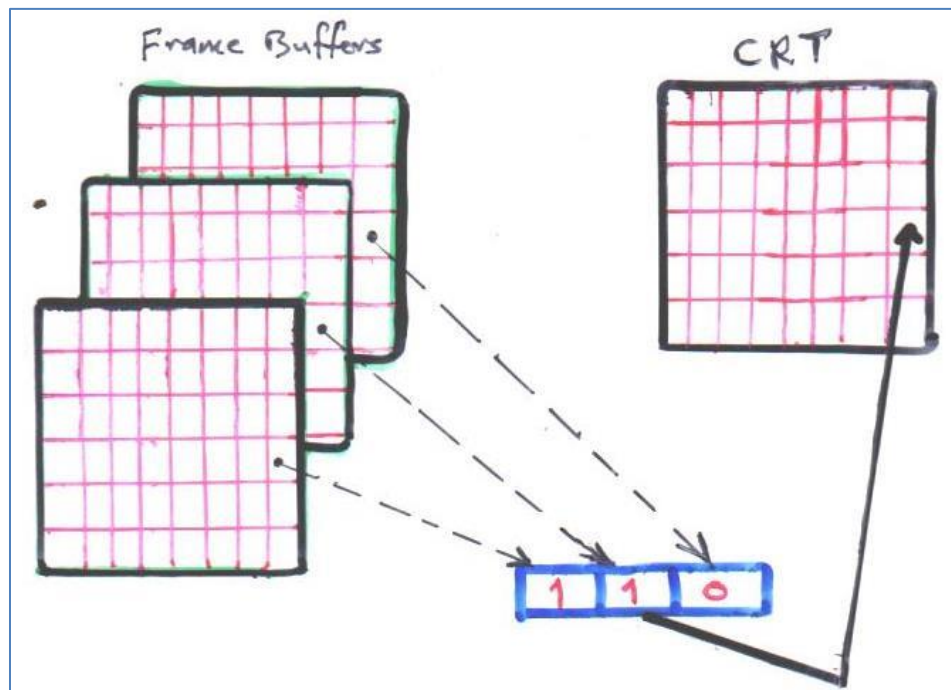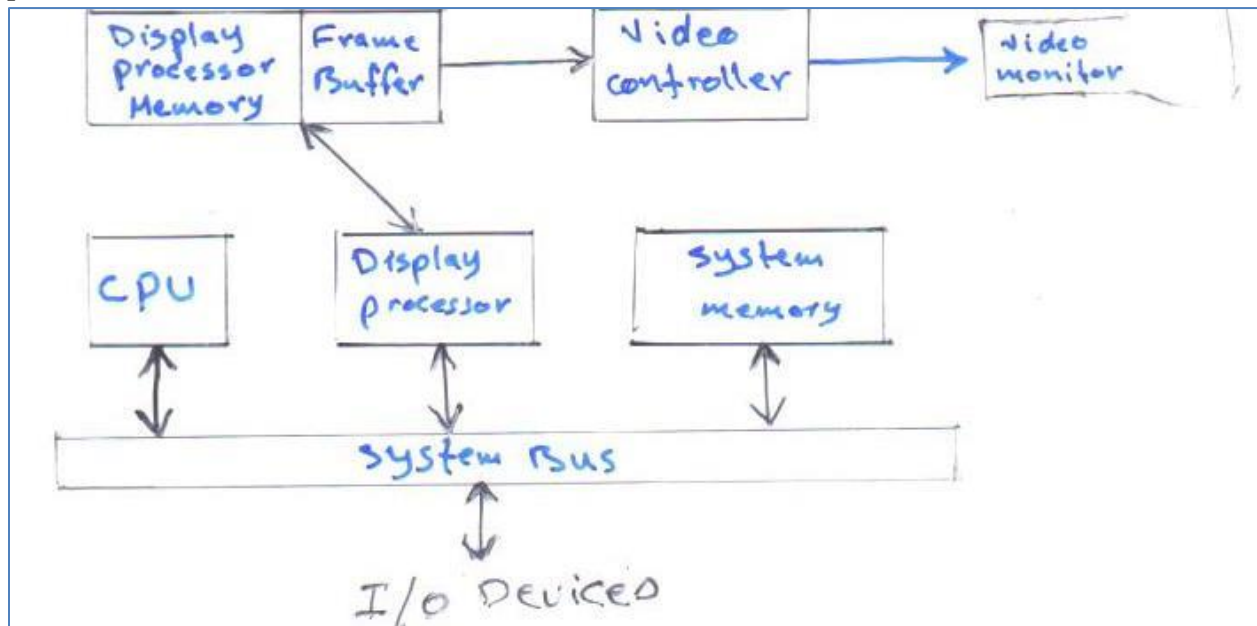
Three – Bit – Plane Frame Buffer

Each screen location pixel and corresponding memory location in the frame buffer is accessed by a (x,y) integer coordinates pair. The x value refers to the column. The y value refers to the row position.
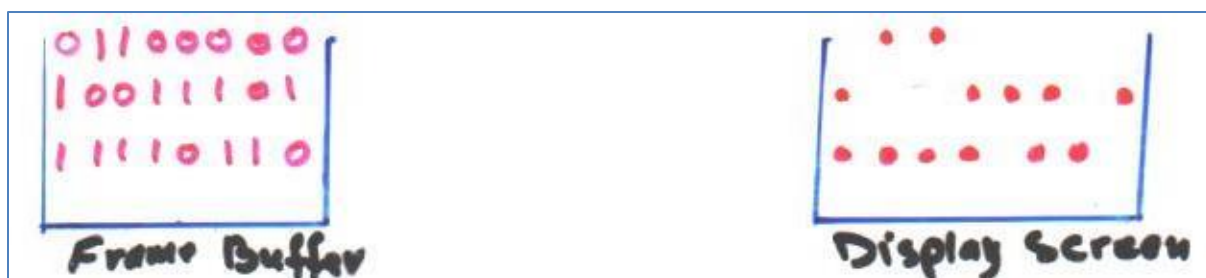
Raster- Scan display processor

Also it called a graphics controller. The purpose of the display processor is to free the CPU from the chores. A major task of the display processor is digitizing a picture definition given in an application program into a set of pixel values for storage in the frame buffer. This digitization process is called **Scan conversion**.

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Graphics commands specifying straight lines and other geometric objects are scan converted into a set of discrete points corresponding to screen pixel position. Scan is converting a straight line segment, means that we have to locate the pixel positions closest to the line path and store the color for each position in the frame buffer.

Architecture of a raster-graphics system with a display processor

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Screen modes

- Text mode
- Graphics mode

Your computer screen could be at any time when the power is oN in one of two modes:

1- Text mode

It is the default mode, In this mode the screen is divided into number of rows and columns displaying only characters from the ASCII characters code.

2- Graphics mode

- In this mode the screen is divided into number of rows and columns each row consists of a specific numbers of dots called pixels. Number of pixels in each row depends on the type of screen used.
- Require more works than using Text mode.
- You must develop methods for drawing lines and characters.
- Single character is made up of many pixels arranged in a pattern that forms character.
- You can light a pixel anywhere on your display.

Screen types

The most common type of CRT display technologies are:

1- Monochrome: uses only black and white color.
2- CGA (Color Graphics Adaptor): It has low resolution. Pixels are large 320 horizontally and 200 vertically.
3- VGA (Virtual Graphics Array) : It has high resolution. 480 pixels horizontally and 640 vertically.
4- SVGA (Super Video Graphics Array): High resolution 800 x 600 pixel
5- XGA (eXtended Graphics Array): High resolution 1024 x 768 pixel
6- SXGA (Super eXtended Graphics Array): High resolution 1280 x 1024 pixel.
7- LCD (Liquid Crystal Display):
diagonal size 22 inches display 1680 X 1050
diagonal size 23 inches display 1920 X 1080
diagonal size 24 inches display 1920 X 1200

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8- Plasma display

A Plasma Display Panel (PDP) is type of flat panel display common to large TV display 30 inches or larger. They are called "Plasma" display because the technology utilizes small cells containing electrically charged ionized gases. The most common native resolution for plasma display panel are:

853 x 480 pixels

1024 x 768 pixels

1920 x 1080 pixels

Screen resolution is always stated as a horizontal number of pixels by the vertical number of pixels.

A screen display 800 x 600 pixels has 600 rows each 800 pixels wide.

CRT display is the most commonly used from of visual displays through it is getting gradually replaced with LCD and plasma display.

Graphics workstations and viewing systems

➢ CRT and flat-panel operate as raster-scan display.

➢ Graphics workstations range from small general-purpose computer system to multi-monitor facilities.

➢ Personal computer screen resolutions vary from about 640 by 480 to 1280 by 1024 pixels.

➢ A diagonal screen length measure from 12 inches to over 21 inches.

➢ Some special screen resolution vary from 1280 by 1024 to about 1600 by 1200 with 18 inches or more diagonal.

➢ High-definition graphics system with resolution up to 2560 by 2048 is used in medical imaging , air-traffic control, simulation and CAD.

➢ Some large viewing screens like:

1- Large screen system for stereoscopic viewing

2- Multi- channel wide –screen system

3- Multi panel display screen (wall-sized viewing areas) used in meetings, conferences, conventions, trade show, museum and

passenger terminal. *Each panel displays one section of the overall picture.*

Input Devices

The most common input devices used in graphics workstations are:

1- Keyboards

Used to enter text string, issuing commands, selecting menu options. Keyboard has cursor control keys and function keys.

2- Mouse devices

A small hand-held unit that moves around on a flat surface to position the screen cursor.

3- Digitizer

A device used for drawing, painting or interactively selecting positions and can be designed to input coordinate values in either a 2D or 3D space.

It is used to scan drawing or object and to input a set of discrete coordinate positions. The input positions are then joined with straight line segments to generate an approximation of a curve or surface shape.

4- Image scanners

This device can store drawings, graphics, photographs or text for computer processing by passing an optical scanning mechanism over the information to be stored.

5- Touch panels

Displayed objects or screen positions can be selected with the touch of finger usually for the selection of processing option that are represented as a graphical icons.