
**SCHOOL OF COMPUTING & IT**

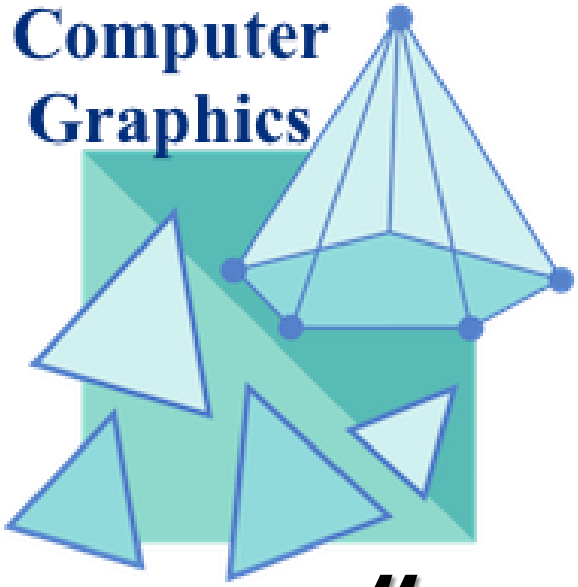
**DEPARTMENT OF COMPUTER SCIENCE, INFORMATION TECHNOLOGY, AND BUSINESS INFORMATION TECHNOLOGY**

# MODULE:
# MULTIMEDIA & COMPUTER GRAPHICS

**From Saturday: 05th April 2025 - To : Sunday 27th April 2025**

**By MWESIGE THIERRY, MScIT**

**CAT DATE: 20th April 2025 & Exam Date: 27th April 2025**




# “CHAP III: COMPUTER GRAPHICS”

UNIVERSITY Of KIGALI

*By MWESIGE THIERRY*

# 3.0 Introduction of Computer Graphics

The term 'Computer Graphics' was coined by Verne Hudson and William Fetter from Boeing who were pioneers in the field. Computer graphics is a dynamic and essential field within computing that involves the creation, manipulation, and rendering of visual content using computers.

In today's digital era, computer graphics technologies have revolutionized how we perceive and interact with visual information, playing a pivotal role in video games, movies, architectural design, medical imaging, and more. There are several tools used for the implementation of Computer Graphics. The basic is the graphics. header file in Turbo-C, Unity for advanced, and even OpenGL can be used for its Implementation.

This article delves into the fundamental concepts of computer graphics, its diverse applications, and the underlying technologies that drive innovation in this field.

# 3.0 Introduction of Computer Graphics

Computer Graphics involves technology to access. The Process transforms and presents information in a visual form. The role of computer graphics insensible. In today life, computer graphics has now become a common element in user interfaces, T.V. commercial motion pictures.

Computer Graphics is the creation of pictures with the help of a computer. The end product of the computer graphics is a picture it may be a business graph, drawing, and engineering.

In computer graphics, two or three-dimensional pictures can be created that are used for research. Many hardware devices algorithm has been developing for improving the speed of picture generation with the passes of time. It includes the creation storage of models and image of objects. These models for various fields like engineering, mathematical and so on.

Today computer graphics is entirely different from the earlier one. It is not possible. It is an interactive user can control the structure of an object of various input devices.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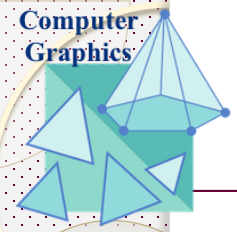

# 3.1 What is Computer Graphics?

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# 3.1 What is Computer Graphics?

" It is **difficult** to **display** an image of any size on the **computer screen**. **This method is simplified by using Computer graphics.**"

Graphics on the computer are produced by using various algorithms and techniques. This tutorial describes how a rich visual experience is provided to the user by explaining how all these processed by the computer.

Computer Graphics including digital images, animations, and interactive graphics used in various sectors such as entertainment, education, scientific visualization, and virtual reality. Computer Graphics can be used in UI design, rendering, geometric objects, animation, and many more. In most areas, computer graphics is an abbreviation of CG.

# 3.1 What is Computer Graphics?

# 3.1 What is Computer Graphics?

## Definition of Computer Graphics:

" It is the use of computers to create and manipulate pictures on a display device. It comprises of software techniques to create, store, modify, represents pictures."

Computer graphics also refers to a technology that generates images on a computer screen. It's used in digital photography, film and television, video games, and on electronic devices and is responsible for displaying images effectively to users

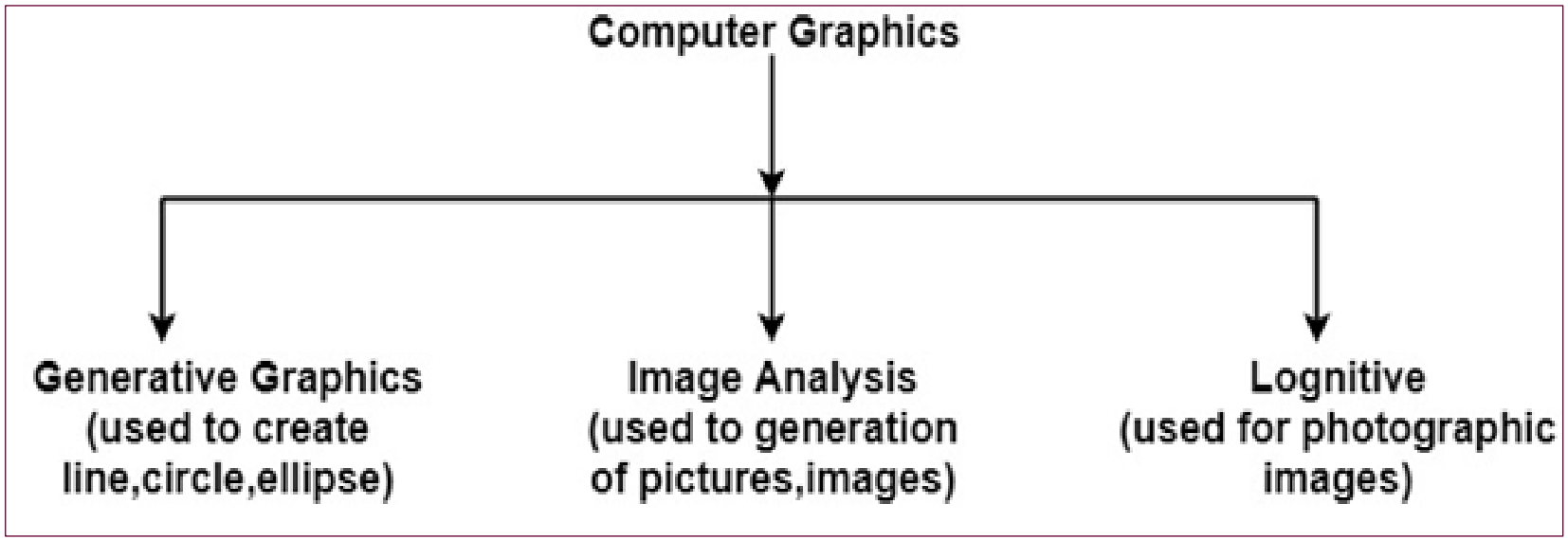
In general terms, the word "graphic" refers to any visual representation of data and includes a variety of forms including drawings, photographs, line art, graphs, diagrams, numbers, symbols, geometric designs, maps, and engineering drawings.

# 3.2 Why computer graphics used?

Suppose a shoe manufacturing company want to show the sale of shoes for five years. For this vast amount of information is to store. So a lot of time and memory will be needed. This method will be tough to understand by a common man. In this situation graphics is a better alternative. Graphics tools are charts and graphs. Using graphs, data can be represented in pictorial form. A picture can be understood easily just with a single look.

Interactive computer graphics work using the concept of two-way communication between computer users. The computer will receive signals from the input device, and the picture is modified accordingly. Picture will be changed quickly when we apply command.

# 3.2 Why computer graphics used?



# 3.3 APPLICATION OF COMPUTER GRAPHICS

# 3.3 APPLICATION OF COMPUTER GRAPHICS

**1. Education and Training:** Computer-generated model of the physical, financial and economic system is often used as educational aids. Model of physical systems, physiological system, population trends or equipment can help trainees to understand the operation of the system.

For some training applications, particular systems are designed. For example Flight Simulator.

**Flight Simulator:** It helps in giving training to the pilots of airplanes. These pilots spend much of their training not in a real aircraft but on the ground at the controls of a Flight Simulator.

**Advantages:**

1. Fuel Saving
2. Safety
3. Ability to familiarize the training with a large number of the world's airports.

# 3.3 APPLICATION OF COMPUTER GRAPHICS

**2. Use in Biology:** Molecular biologist can display a picture of molecules and gain insight into their structure with the help of computer graphics.

**3. Computer-Generated Maps:** Town planners and transportation engineers can use computer-generated maps which display data useful to them in their planning work.

**4. Architect:** Architect can explore an alternative solution to design problems at an interactive graphics terminal. In this way, they can test many more solutions that would not be possible without the computer.

**5. Presentation Graphics:** Example of presentation Graphics are bar charts, line graphs, pie charts and other displays showing relationships between multiple parameters.

# 3.3 APPLICATION OF COMPUTER GRAPHICS

Presentation Graphics is commonly used to summarize:

- Financial Reports
- Statistical Reports
- Mathematical Reports
- Scientific Reports
- Economic Data for research reports
- Managerial Reports
- Consumer Information Bulletins
- And other types of reports

# 3.4 Example of Computer Graphics Packages:

1. LOGO
2. COREL DRAW
3. AUTO CAD
4. 3D STUDIO
5. CORE
6. GKS (Graphics Kernel System)
7. PHIGS
8. CAM (Computer Graphics Metafile)
9. CGI (Computer Graphics Interface)

# 3.5 TYPES OF COMPUTER GRAPHICS

There are two main types of Computer graphics:

1. Non-Interactive or Passive Computer Graphics
2. Interactive Computer Graphics

## 1. Non-Interactive or Passive Computer Graphics

In non-interactive computer graphics, the picture is produced on the monitor, and the user does not have any controlled over the image, i.e., the user cannot make any change in the rendered image. One example of its Titles shown on T.V.

Non-interactive Graphics involves only one-way communication between the computer and the user, User can see the produced image, and he cannot make any change in the image.

# 3.5 TYPES OF COMPUTER GRAPHICS

## 2. Interactive Computer Graphics

In interactive Computer Graphics user have some controls over the picture, i.e., the user can make any change in the produced image. One example of it is the ping-pong game.

Interactive Computer Graphics require two-way communication between the computer and the user. A User can see the image and make any change by sending his command with an input device.

**Advantages:**

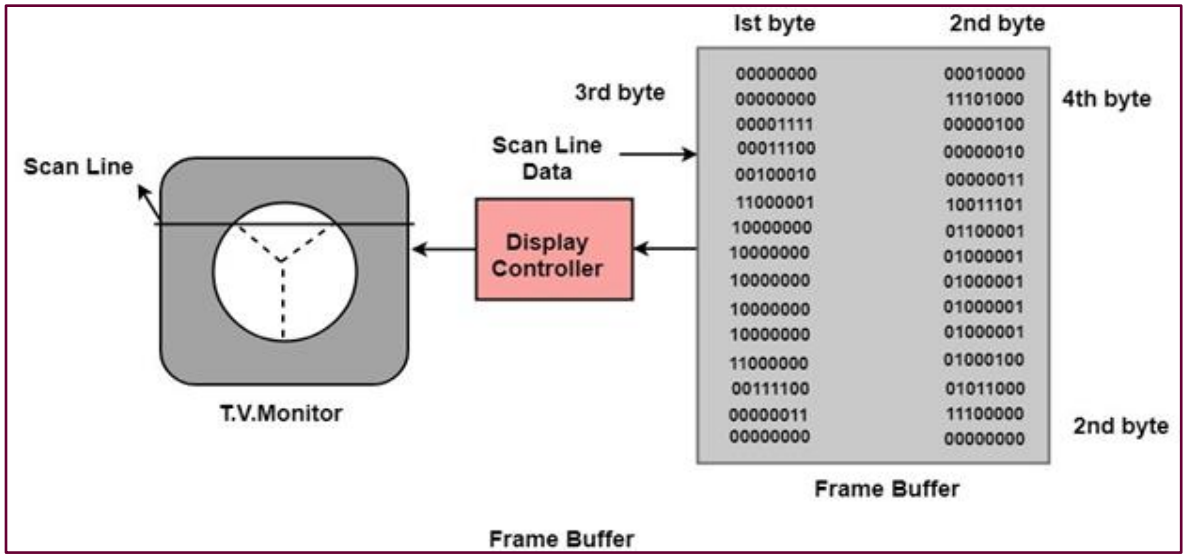
1. Higher Quality
2. More precise results or products
3. Greater Productivity
4. Lower analysis and design cost
5. Significantly enhances our ability to understand data and to perceive trends.

# 3.5 TYPES OF COMPUTER GRAPHICS

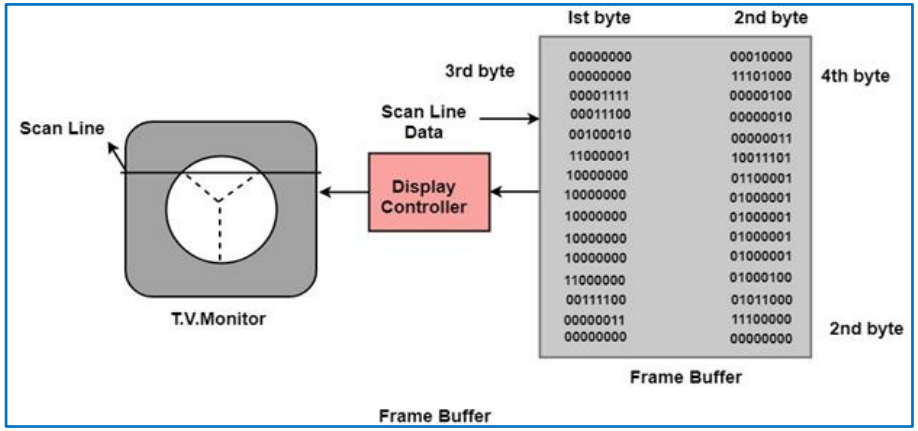
**Working of Interactive Computer Graphics:**

The modern graphics display is very simple in construction. It consists of three components:

1. Frame Buffer or Digital Memory
2. A Monitor likes a home T.V. set without the tuning and receiving electronics.
3. **Display Controller or Video Controller:** It passes the contents of the frame buffer to the monitor.



# 3.5 TYPES OF COMPUTER GRAPHICS




Frame Buffer: A digital frame buffer is large, contiguous piece of computer memory used to hold or map the image displayed on the screen.

- At a minimum, there is 1 memory bit for each pixel in the raster. This amount of memory is called a bit plane.
- A 1024 x 1024 element requires 220 (210=1024;220=1024 x 1024)sq.raster or 1,048,576 memory bits in a single bit plane.
- The picture is built up in the frame buffer one bit at a time.
- ∵ A memory bit has only two states (binary 0 or 1), a single bit plane yields a black and white (monochrome display).
- As frame buffer is a digital device write raster CRT is an analog device.

# 3.6 Properties of Video Monitor

1. **Persistence:** Persistence is the duration of phosphorescence. Different kinds of phosphors are available for use in CRT. Besides color, a major difference between phosphor in their persistence how they continue to emit light after the electron beam is removed.

**2. Resolution:** Use to describe the number of pixels that are used on display image.

**3. Aspect Ratio:** It is the ratio of width to its height. Its measure is unit in length or number of pixels.

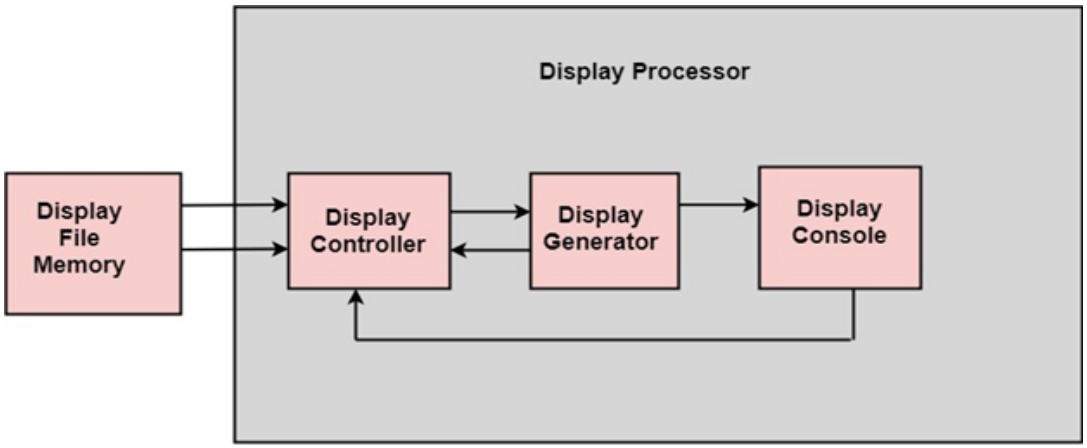
$$\text{Aspect Ratio} = \frac{\text{width unit}}{\text{height unit}}$$

# 3.7 DISPLAY PROCESSOR

It is interpreter or piece of hardware that converts display processor code into pictures. It is one of the four main parts of the display processor

Parts of Display Processor

1. Display File Memory
2. Display Processor
3. Display Generator
4. Display Console




Block diagram of Display System

# 3.7 DISPLAY PROCESSOR

**Display File Memory:** It is used for generation of the picture. It is used for identification of graphic entities.

**Display Controller:**

1. It handles interrupt
2. It maintains timings
3. It is used for interpretation of instruction.

**Display Generator:**

1. It is used for the generation of character.
2. It is used for the generation of curves.

**Display Console:** It contains CRT, Light Pen, and Keyboard and deflection system.

The raster scan system is a combination of some processing units. It consists of the control processing unit (CPU) and a particular processor called a display controller. Display Controller controls the operation of the display device. It is also called a video controller.

**Working:** The video controller in the output circuitry generates the horizontal and vertical drive signals so that the monitor can sweep. Its beam across the screen during raster scans.

# 3.7 DISPLAY PROCESSOR

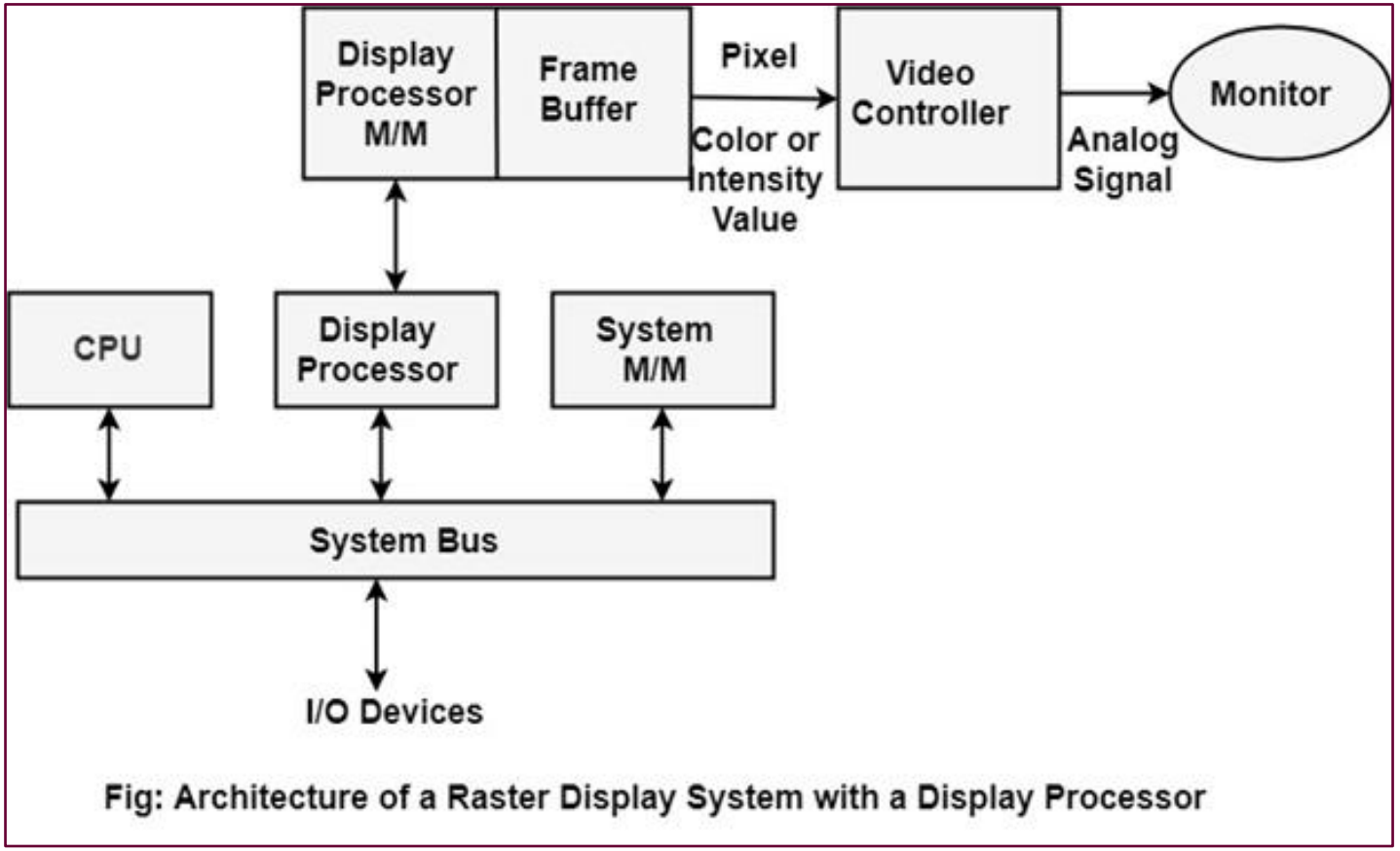



Fig: Architecture of a Raster Display System with a Display Processor

# 3.7 DISPLAY PROCESSOR

- As fig showing that 2 registers (X register and Y register) are used to store the coordinate of the screen pixels. Assume that y values of the adjacent scan lines increased by 1 in an upward direction starting from 0 at the bottom of the screen to $y_{max}$ at the top and along each scan line the screen pixel positions or x values are incremented by 1 from 0 at the leftmost position to $x_{max}$ at the rightmost position.
- The origin is at the lowest left corner of the screen as in a standard Cartesian coordinate system.

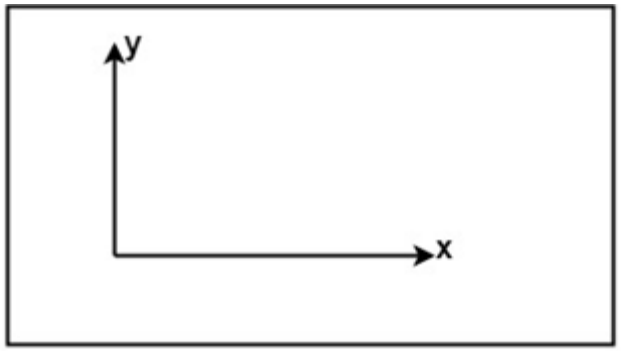



Fig: The origin of the coordinate system for identifying screen positions is usually specified in the lower-left corner.

# 3.7 DISPLAY PROCESSOR

At the start of a **Refresh Cycle**:

X register is set to 0 and y register is set to $y_{max}$. This (x, y') address is translated into a memory address of frame buffer where the color value for this pixel position is stored.

The controller receives this color value (a binary no) from the frame buffer, breaks it up into three parts and sends each element to a separate Digital-to-Analog Converter (DAC).

These voltages, in turn, controls the intensity of 3 e-beam that are focused at the (x, y) screen position by the horizontal and vertical drive signals.

This process is repeated for each pixel along the top scan line, each time incrementing the X register by Y.

As pixels on the first scan line are generated, the X register is incremented through$x_{max}$.

Then x register is reset to 0, and y register is decremented by 1 to access the next scan line.

# 3.7 DISPLAY PROCESSOR

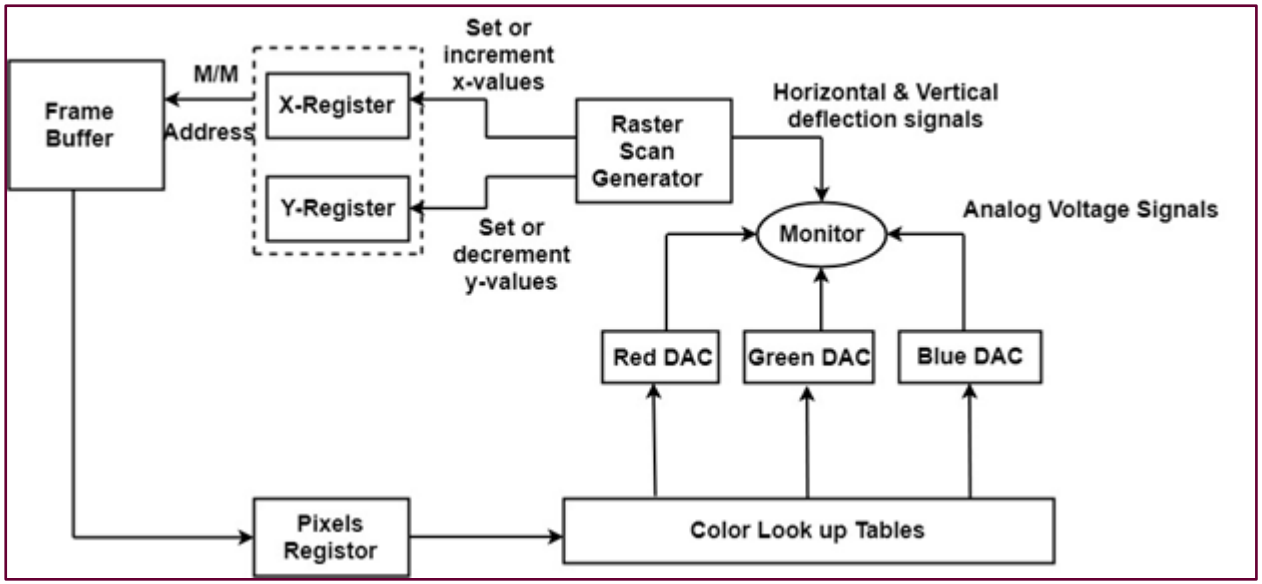
Pixel along each scan line is then processed, and the procedure is repeated for each successive scan line units pixels on the last scan line (y=0) are generated.

For a display system employing a color look-up table frame buffer value is not directly used to control the CRT beam intensity.

It is used as an index to find the three pixel-color value from the look-up table. This lookup operation is done for each pixel on every display cycle.

As the time available to display or refresh a single pixel in the screen is too less, accessing the frame buffer every time for reading each pixel intensity value would consume more time what is allowed:

# 3.7 DISPLAY PROCESSOR




Multiple adjacent pixel values are fetched to the frame buffer in single access and stored in the register.

After every allowable time gap, the one-pixel value is shifted out from the register to control the warm intensity for that pixel.

The procedure is repeated with the next block of pixels, and so on, thus the whole group of pixels will be processed.

# 3.8 Display Devices

The most commonly used display device is a video monitor. The operation of most video monitors based on CRT (Cathode Ray Tube). The following display devices are used:

1. Refresh Cathode Ray Tube
2. Random Scan and Raster Scan
3. Color CRT Monitors
4. Direct View Storage Tubes
5. Flat Panel Display
6. Lookup Table

# ----- END -----

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THANK'S FOR
YOUR ATTENTION
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QUESTIONS?
COMMENTS?
CONCERNS?

# Assignment#3 [Individual Assignment]

**With Types of Computer Graphics Describe 15 reasons why computer graphics are used with their applications.**

**Submit by Friday On 11/April/2025**

**Send to E-mail:**
**mwesigethierry@yahoo.com**