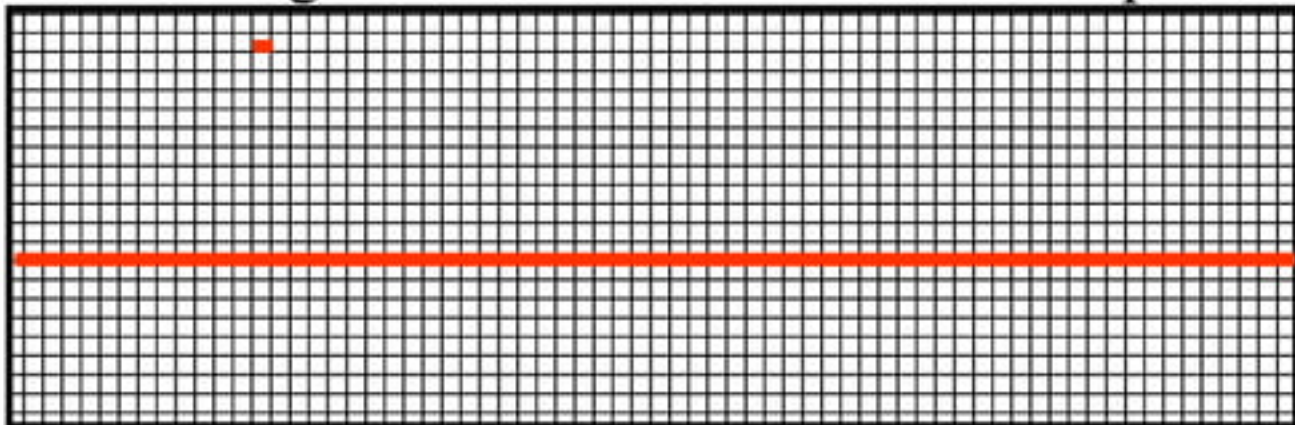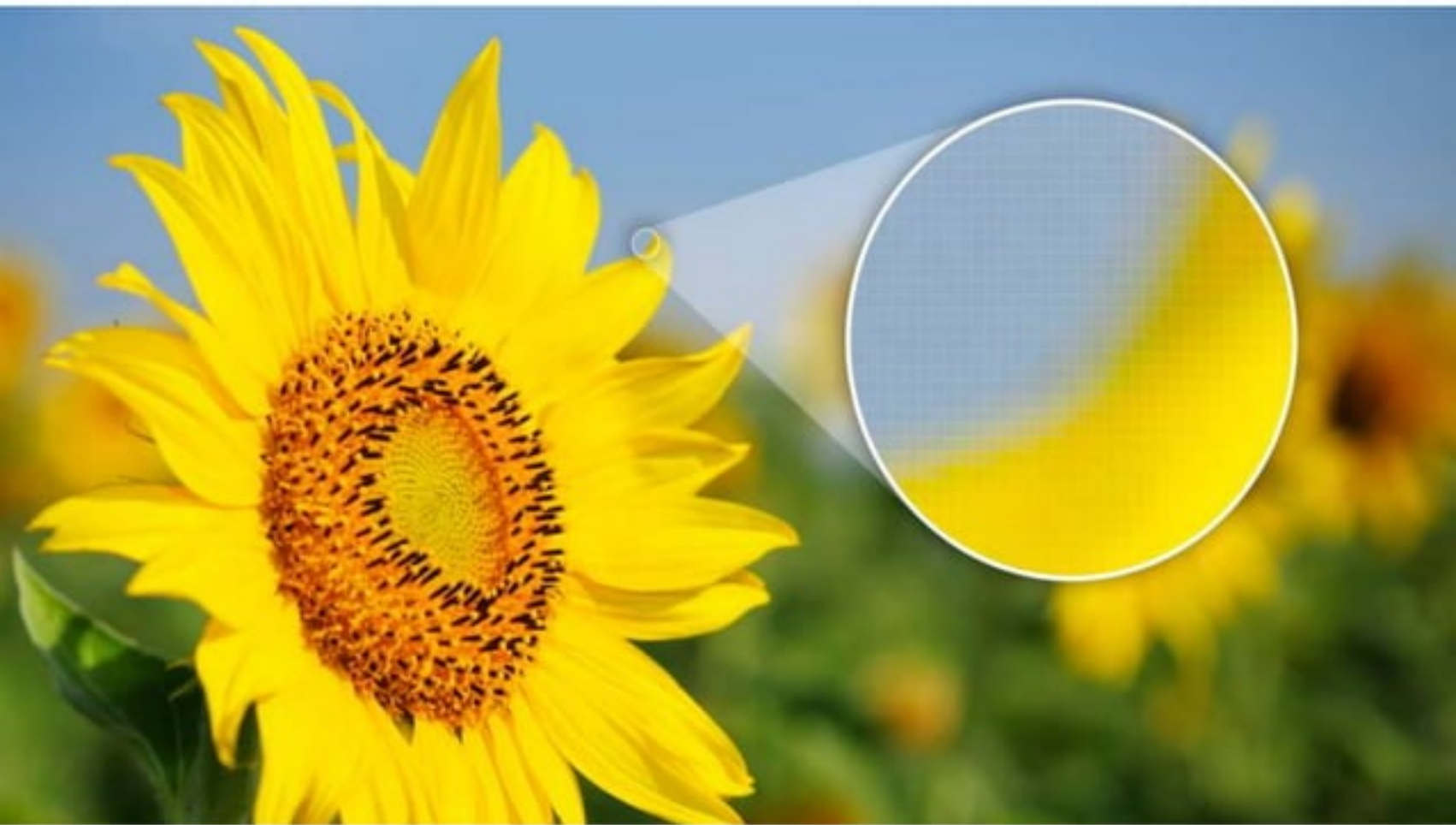# RANDOM SCAN DISPLAYS AND
RASTER SCAN DISPLAYS

RASTER SCAN DISPLAY

- **Raster:** A rectangular array of points or dot.

- An image is subdivided into a sequence of (usually horizontal) strips known as "scan lines" which can be further divided into discrete pixels for processing in a computer system.

A raster image is a collection of dots called pixels

RASTER IMAGE

WORKING

- In a raster scan system, the electron beam is swept across the screen, one row at a time from top to bottom.

- As the electron beam moves across each row, the beam intensity is turned on and off to create a pattern of illuminated spots.

- The return to the left of the screen, after refreshing each scan line is called **Horizontal retrace**.

- At the end of each frame the electron beam returns to the top left corner of the screen to begin the next frame is called **Vertical retrace**:
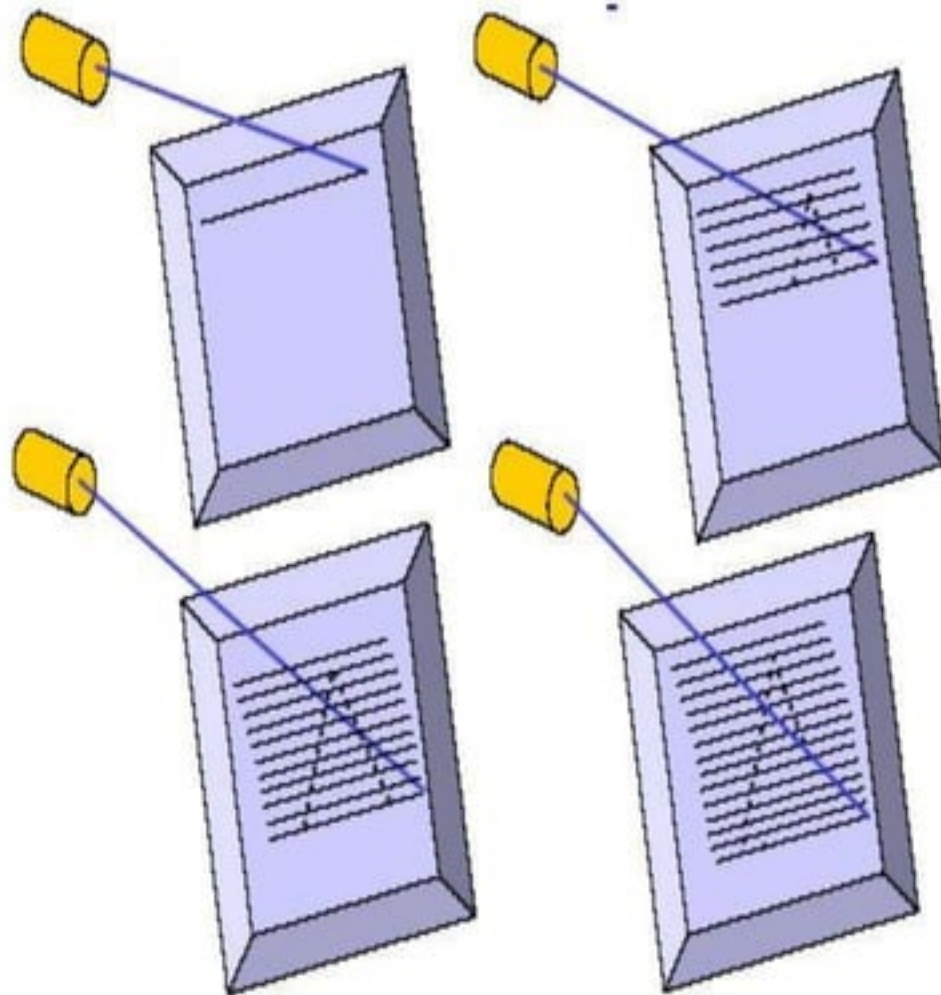
Raster Scan Display
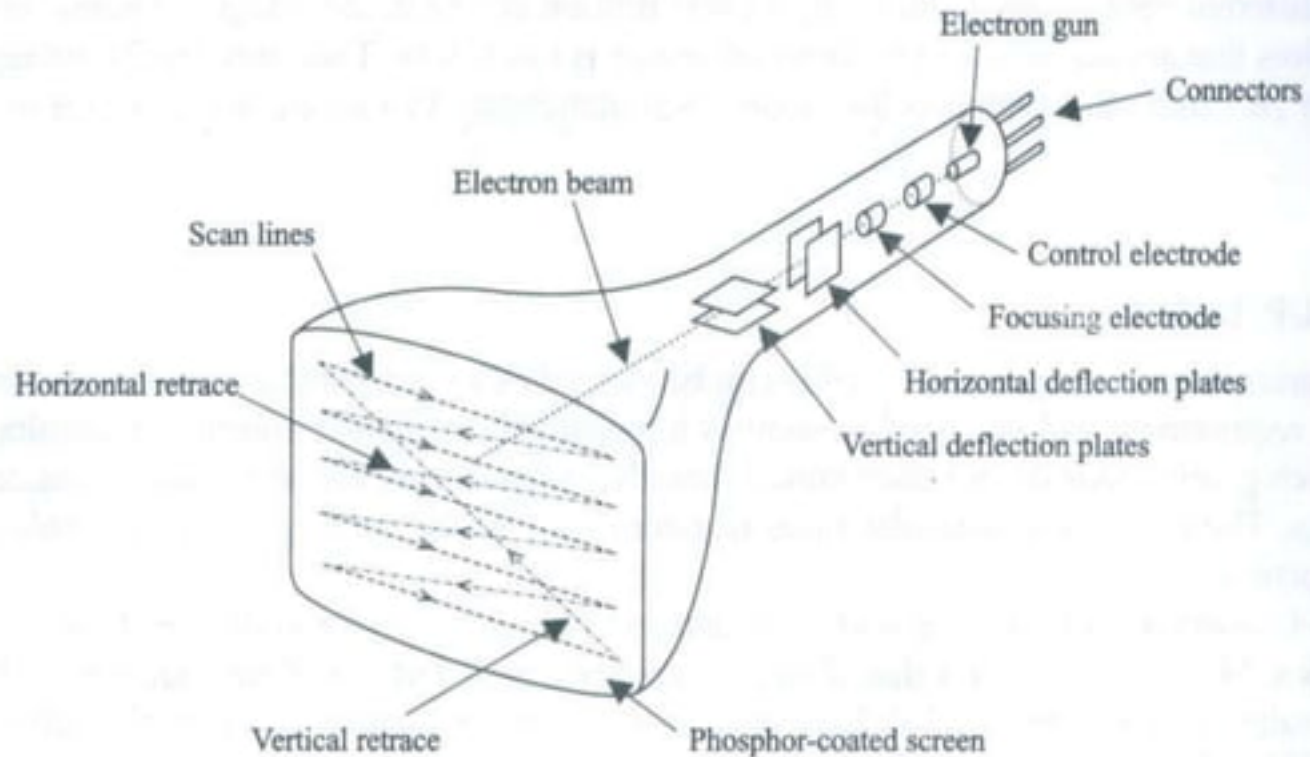
WORKING

- Picture definition is stored in a memory area called the **refresh buffer** or **frame buffer**.

- **Refresh buffer** or **frame buffer** is memory area that holds the set of intensity values for all the screen points.

- Stored intensity values then retrieved from refresh buffer and "**painted**" on the screen one row (**scan line**) at a time.

Object as set of discrete points across each scan line

- The quality of a raster image is determined by the total number pixels (**resolution**), and the amount of information in each pixel (**color depth**)

- A black-and-white system: each screen point is either on or off, so only **one bit** per pixel is needed to control the intensity of screen positions. Such type of frame buffer is called Bit map

- High quality raster graphics system have **24 bits per pixel** in the frame buffer (a **full color** system or a **true color** system)

- Refreshing on raster scan displays is carried out at the rate 60 to 80 frame per second.

INTERLACING

- On some raster systems (TV), each frame is displays in two passes using an interlaced refresh procedure.

- Interlacing is primarily used for slower refresh rates.

- An effective technique to avoid **Flicker**.(Flicker occurs on CRTs when they are driven at a low refresh rate, allowing the brightness to drop for time intervals sufficiently long to be noticed by a human eye)

INTERLACING

Odd Field Even Field

A C B D

Jeff Caunter 1999
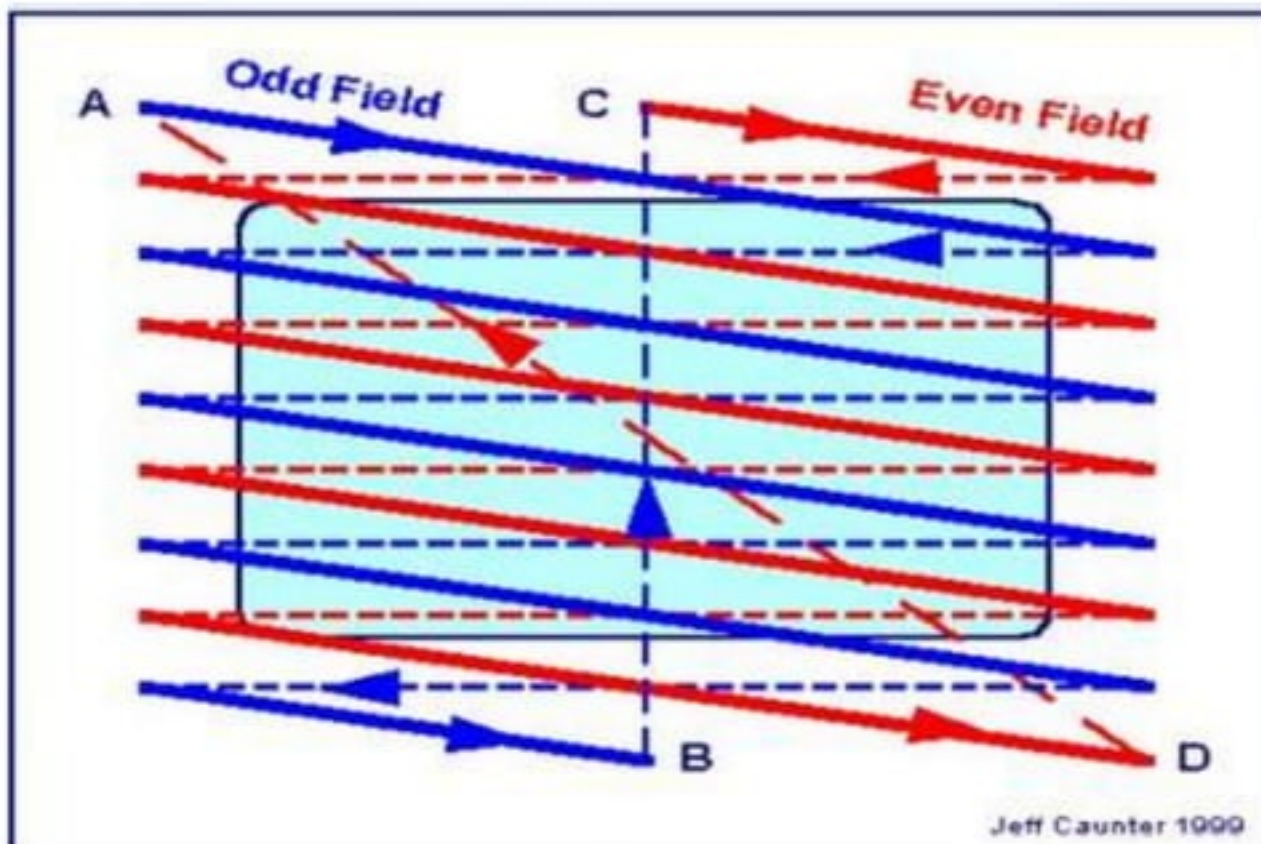
APPLICATIONS

- Suited for realistic display of screens
- Home television computer printers create their images basically by raster scanning. Laser printers use a spinning polygonal mirror (or an optical equivalent) to scan across the photosensitive drum, and paper movement provides the other scan axis

➢ Common raster image formats include BMP (Windows Bitmap), JPEG (Joint Photographics Expert Group), GIF (Graphics Interchange Format) , PNG (Portable Network Graphic), PSD (Adobe PhotoShop)

DISADVANTAGE

- To increase size of a raster image the pixels defining the image are be increased in either number or size Spreading the pixels over a larger area causes the image to lose detail and clarity.
- Produces jagged lines that are plotted as discrete points
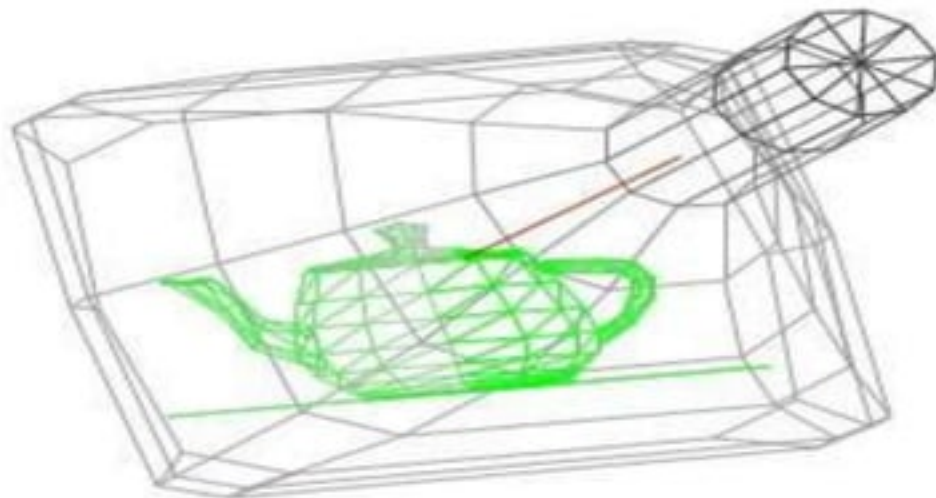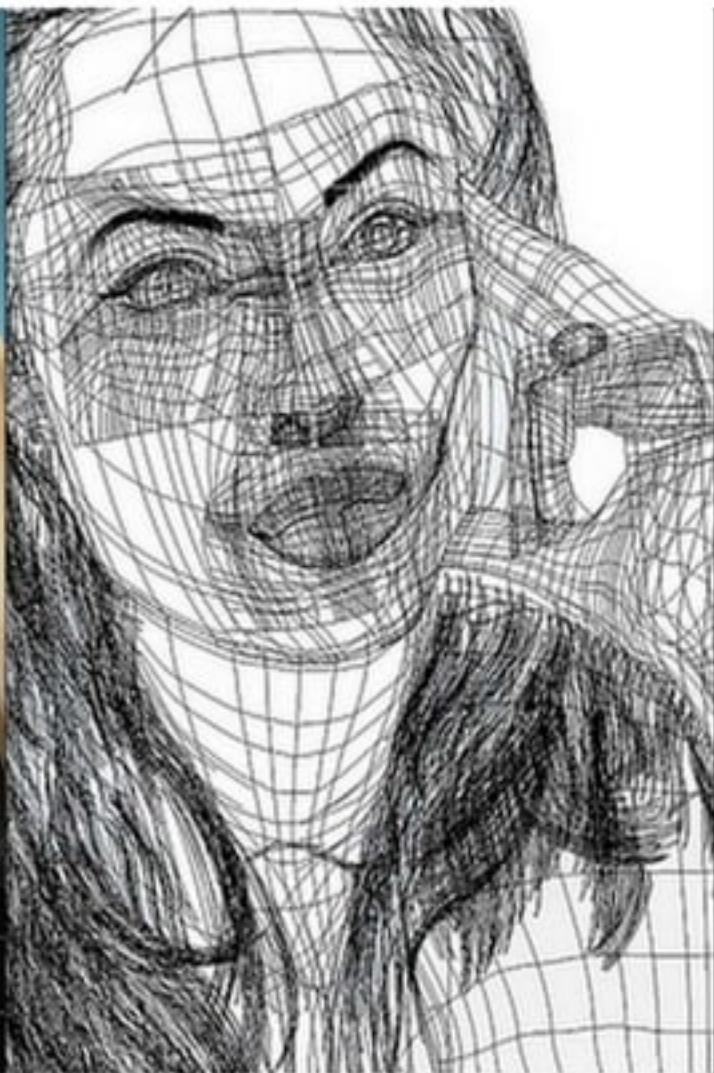
Aliased

Anti-Aliased

RANDOM SCAN DISPLAY

- Random scan display is the use of geometrical primitives such as points, lines, curves, and polygons, which are all based upon **mathematical**
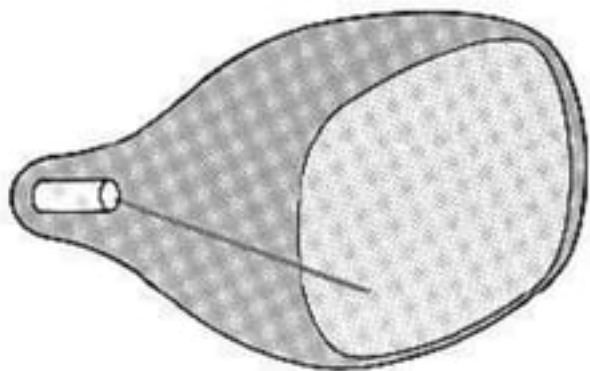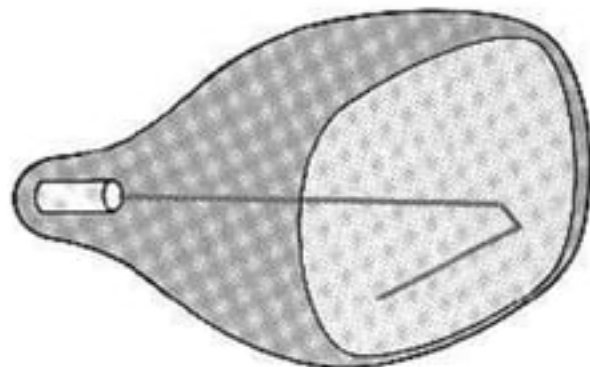
VECTOR IMAGE

WORKING

- When operated as a random-scan display unit, a CRT has the electron beam directed only to the parts of the screen where a picture is to be drawn.

- Random-scan monitors draw a picture one line at a time and for this reason are also referred to as vector displays (or stroke-writing or calligraphic displays).
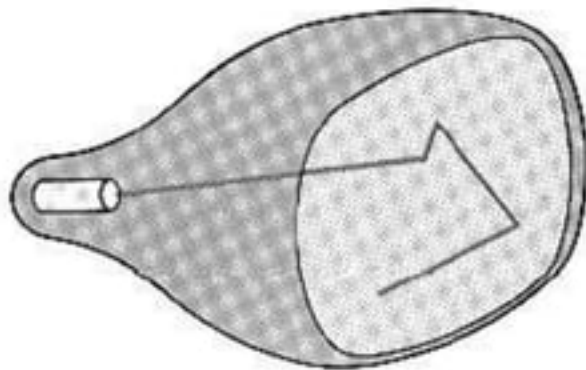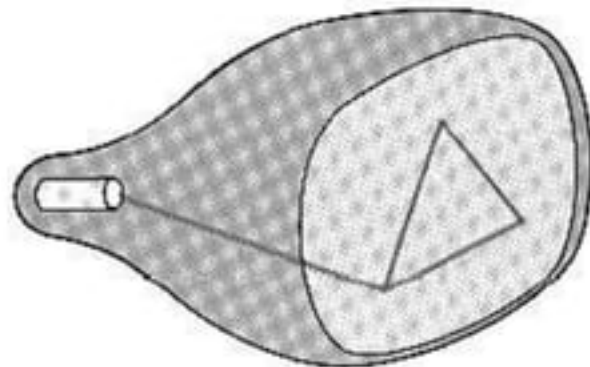
RASTER SCAN DISPLAY

(a)   (b)

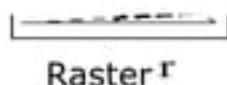(c)   (d)

- **Refresh rate** depends on the number of lines to be displayed.
- Picture definition is now stored as a line-drawing commands an area of memory referred to as **refresh display file (display list)**.
- To display a picture, the system cycle through the **set of commands** in the display file, drawing each component line in turn.
- Random scan displays are designed to draw all the component lines of a picture 30 to 60 times each second

➢A Raster system produces jagged lines that are plotted as discrete points sets.
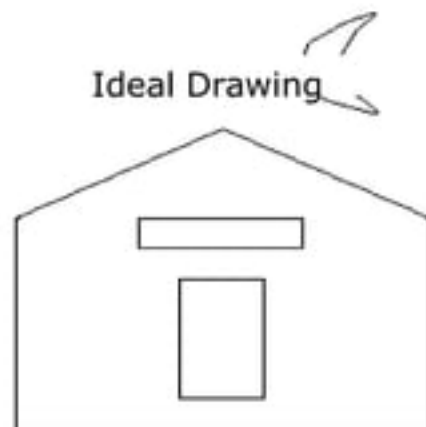

Raster ᵣ

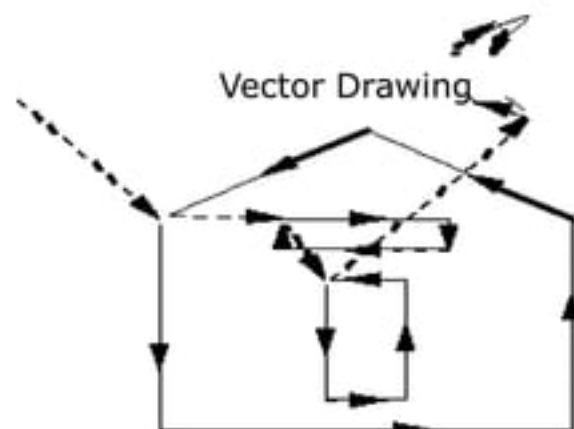Outline primitives   Filled primitives

➢Vector displays product smooth line drawing

Ideal Drawing   Vector Drawing

Ideal Drawing   Vector Drawing

- Random scan displays are designed for **line-drawing applications** and can not display realistic shaded scenes

Advantages

- Random scan displays have higher resolution than raster systems.
- Vector displays product smooth line drawing.
- This minimal amount of information translates to a much smaller file size. (file size compared to large raster images)
- On zooming in, and it remains smooth
- The parameters of obje.cts are stored and can be later modified.

RASTER SCAN SYSTEM

- In addition to the central processing unit (CPU), a special processor, called the **video controller** or **display controller**, is used to control the operation of the display device.

- 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.

- Operation performed:
1. Refreshing operation

2. Transformation (Areas of the screen can be enlarged, reduces, or moved during the refresh cycles)

CPU

Peripheral devices

System bus

System memory | Frame buffer → Video controller → Monitor
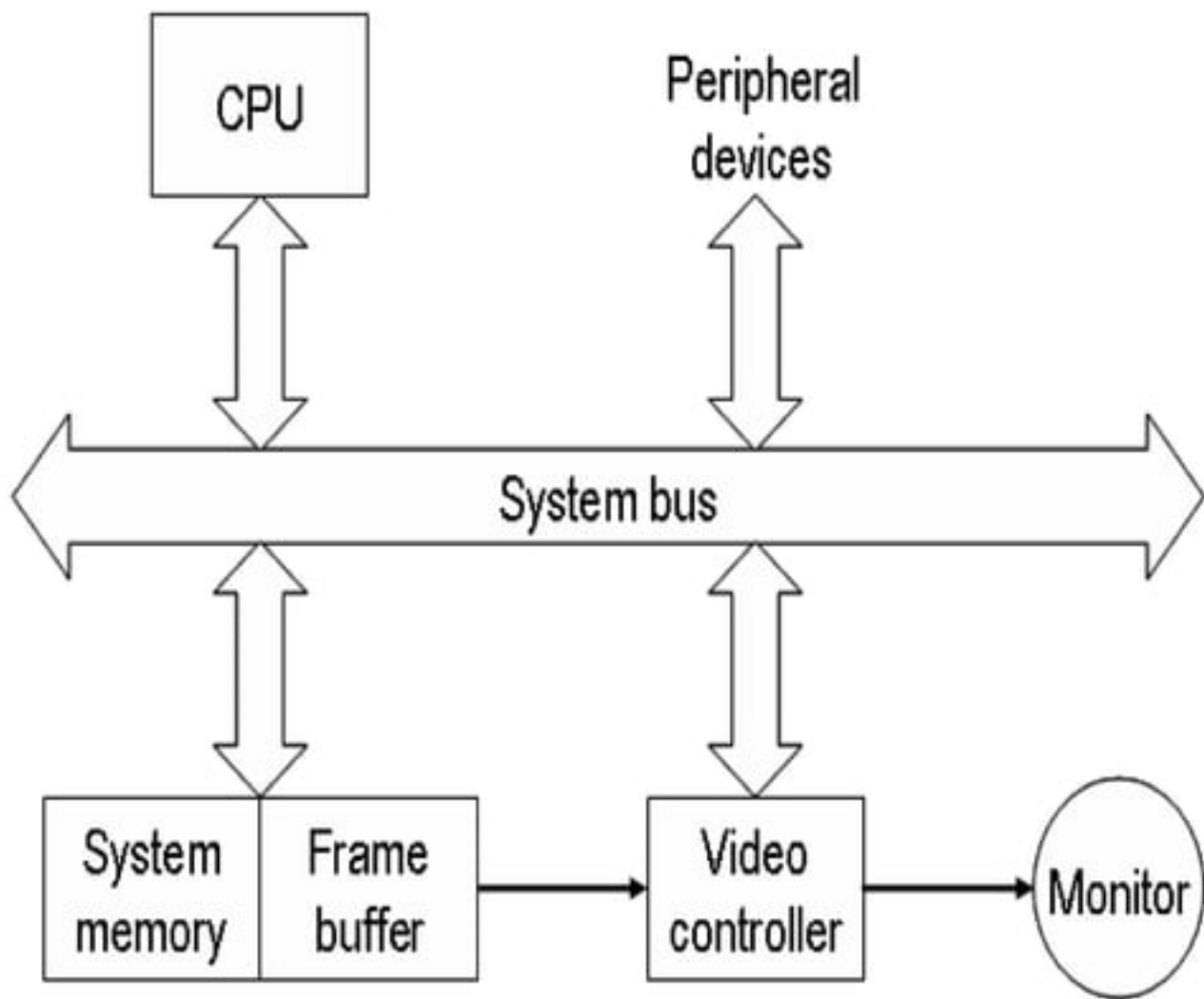
The Basic refresh operation of the video controller.

- **Frame buffer** location, and the corresponding screen positions, are referenced in Cartesian coordinates
- **Scan lines** are then labeled from y_{max} at the top of the screen to 0 at the bottom. Along each scan line, screen **pixel** positions are labeled from 0 to x_{max}
- Two registers are used to store the coordinates of the screen pixels.

Raster Scan Generator

x Register   y Register

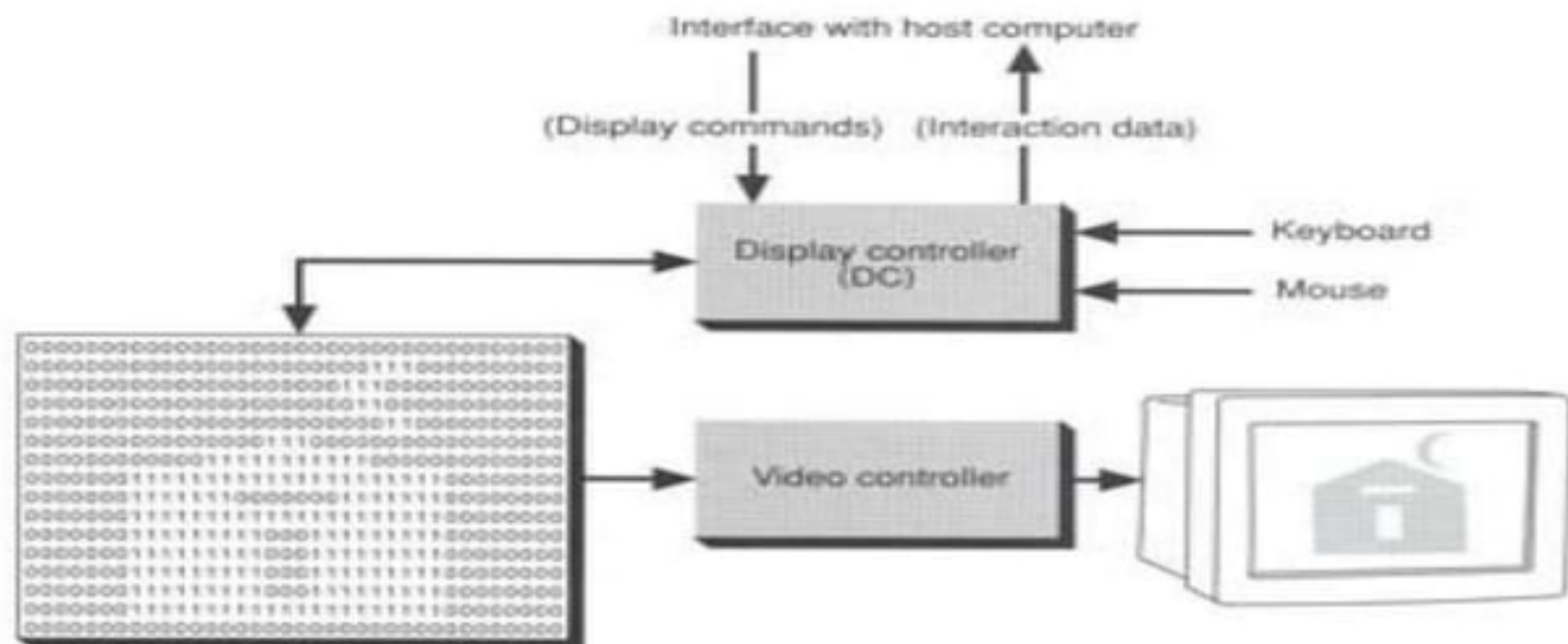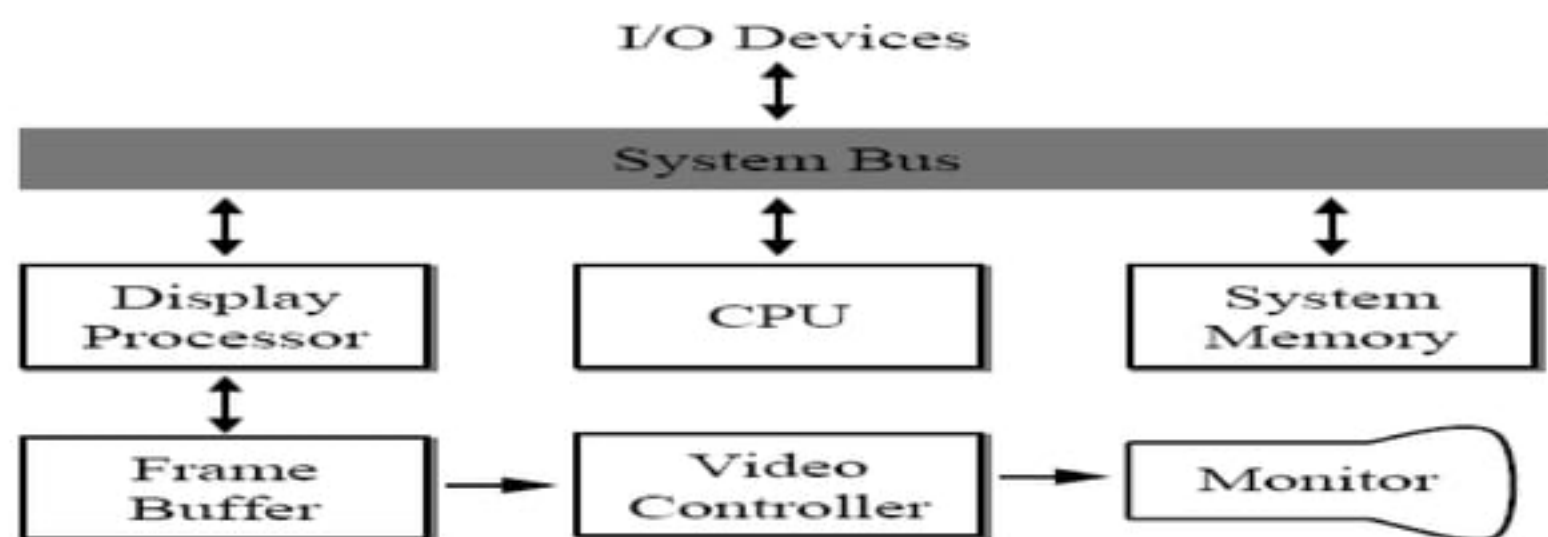Memory Address

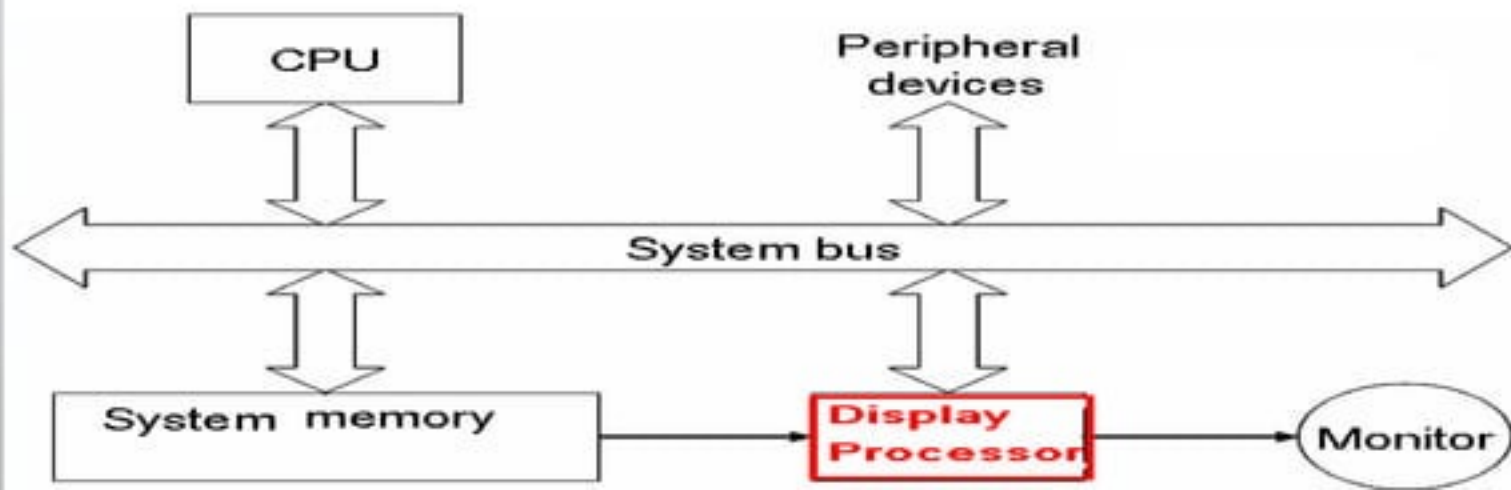Frame Buffer → Intensity
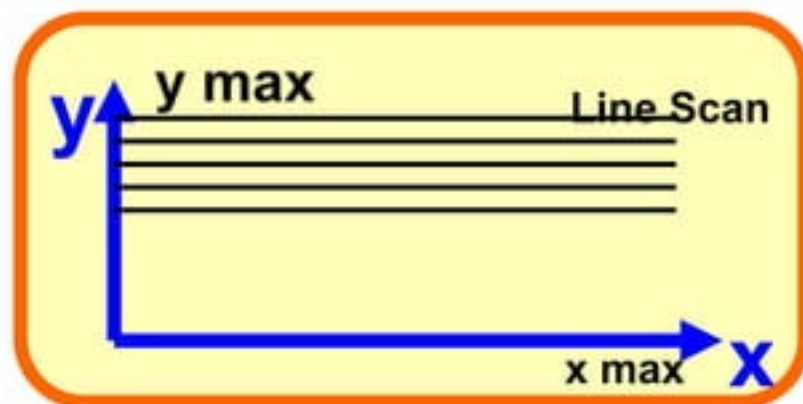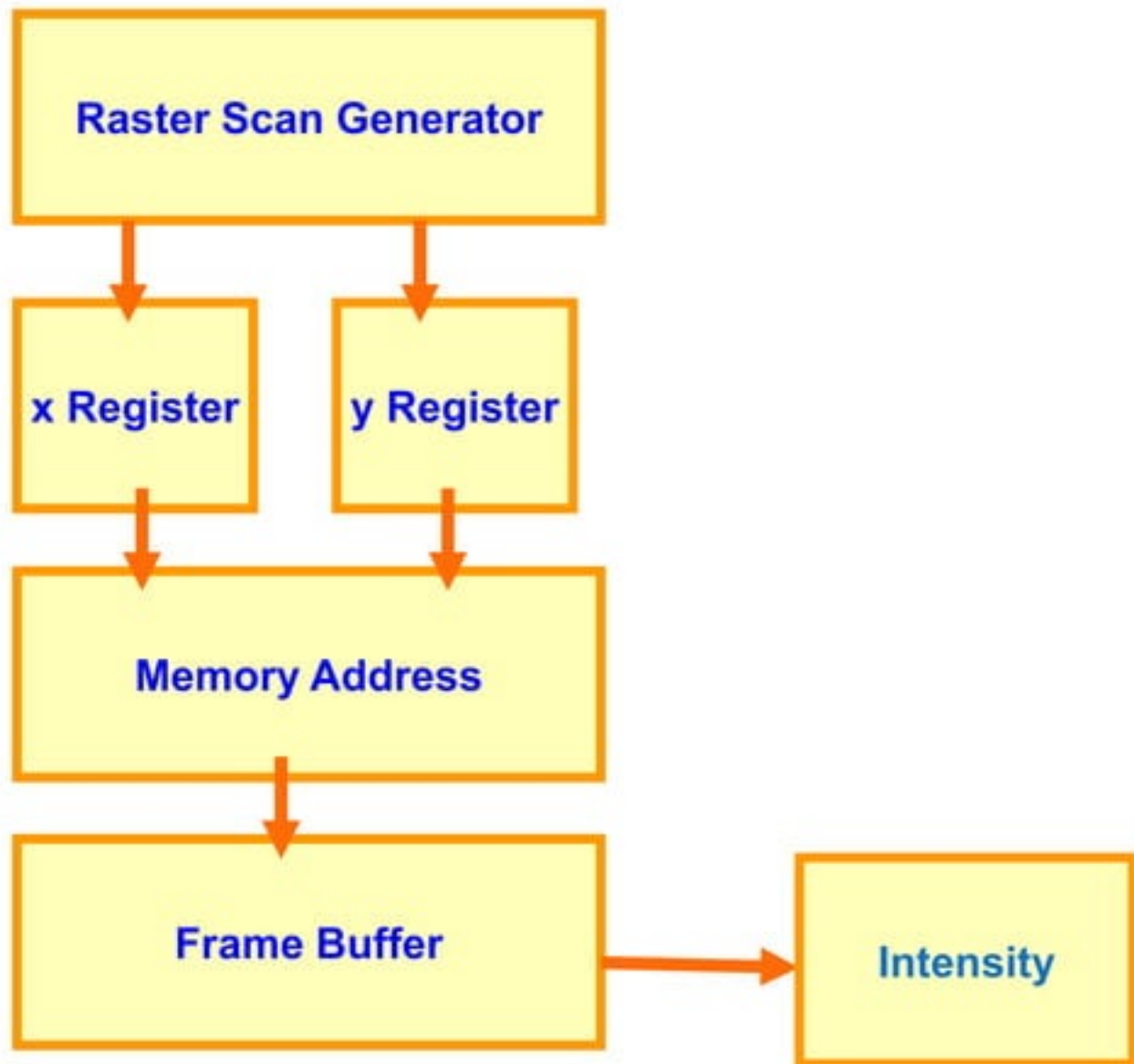
DISPLAY PROCESSOR

- The purpose of the DP is to free the CPU from the graphics chores.

- A major task of the display processor is **Scan Conversion.**

- Scan Conversion: is digitizing a picture definition given in an application program into a set of pixel intensity values for storage in the frame buffer.

I/O Devices

System Bus

| Display Processor | CPU | System Memory |

| Frame Buffer | Video Controller | Monitor |

Interface with host computer

(Display commands)   (Interaction data)

Display controller (DC)
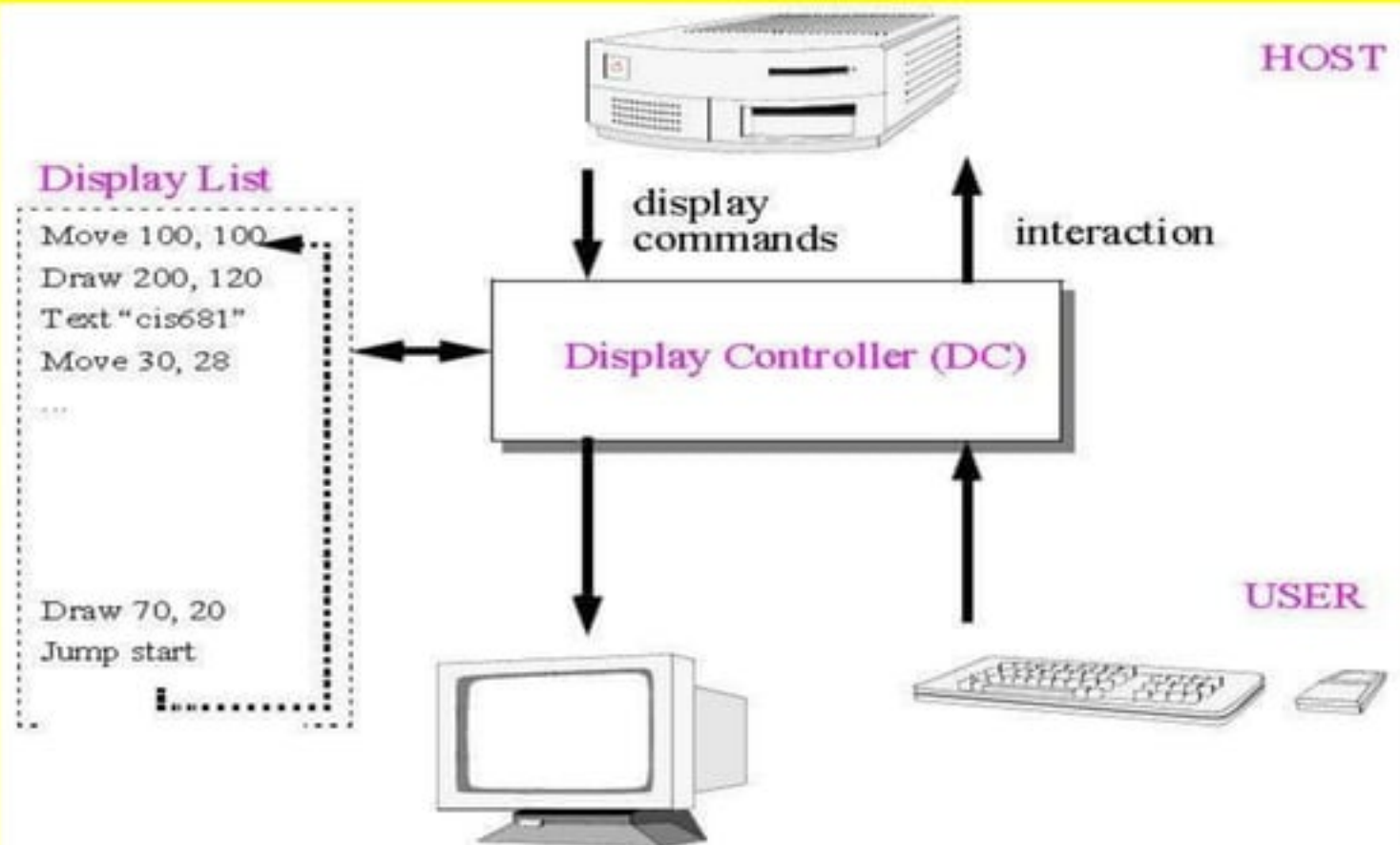
Keyboard

Mouse

Video controller

RASTER SCAN SYSTEM

- Graphic commands are translated by the graphics package into a display file stored in the system memory.

- This file is then accessed by the **display processor unit (DPU)**(graphic controller) to refresh the screen.

RASTER SCAN SYSTEM

HOST

Display List

Move 100, 100
Draw 200, 120
Text "cis681"
Move 30, 28
...

Draw 70, 20
Jump start

display commands

interaction

Display Controller (DC)

USER

THANK YOU

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