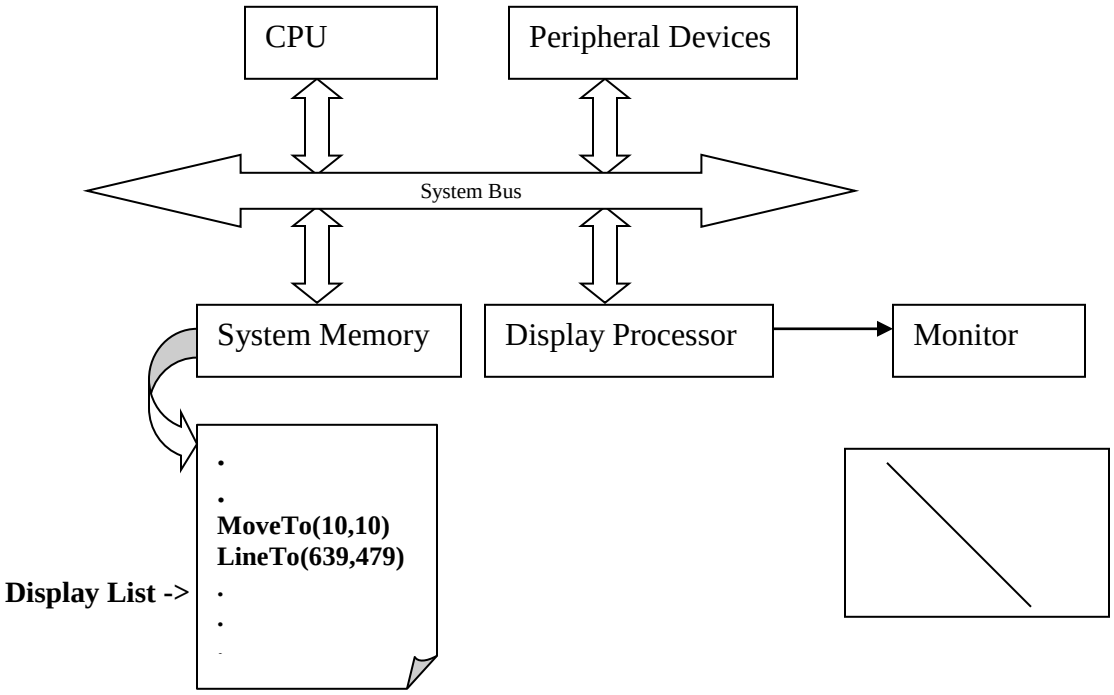
Display Technology

i. Vector Display Technology

Vector display technology was developed in 60's and used as a common display device until 80's , It is also called *random scan, a stroke, a line drawing* or *calligraphic display*



It consists of a central processing unit, a display processor , a monitor , system memory and peripheral devices such as mouse and key board

A display processor is also called a *display processing unit* or *graphics controller*

The application program and *graphics subroutine package* both reside in the system memory and execute on CPU . A graphics subroutine package creates a *display list* and stores in the system memory

A display list contains point and line plotting commands with end point coordinates as well as character plotting commands

The DPU interprets the commands in the display list and plots the respective output primitives such as point, line and characters

As a matter of fact the DPU sends digital point coordinates to a vector generator that converts the digital coordinate values to analog voltages for circuits that displace an electron beam hitting on the CRT's phosphor coating

Therefore the beam is deflected from endpoint to endpoint as dictated by the arbitrary order of the commands in the display list, hence the name *Random Scan Display* Since the light output of the phosphor decays in tens or at most hundreds of microseconds the DPU must cycle thru the display list to refresh the image around 50 times per second to avoid flicker. A portion of the system memory where display list resides is called a *refresh buffer.*

This display technology is used with mono chromatic CRTs or beam penetration color CRTs

Advantages:

i. It can produce a smooth output primitives with higher resolution unlike the raster display technology

ii. It is better than raster display for real time dynamics such as animation

iii. For transformation, only the end points has to be moved to the new position in vector display but in raster display it is necessary to move those end points and at the same time all the pixels between the end points must be scan converted using appropriate algorithm
No prior information on pixels can be reused

Disadvantages:

i. A vector display can not fill areas with patterns and manipulate bits

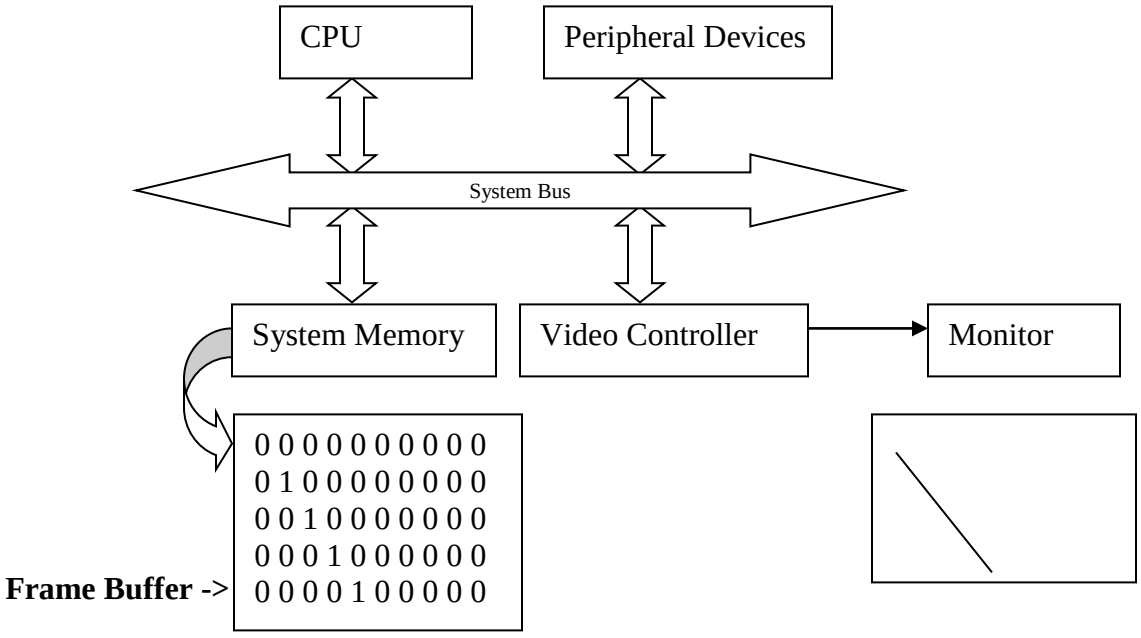
ii. Time required for refreshing an image depends upon its complexity (more the lines , longer the time) the flicker may therefore appear as the complexity of the image increases. The fastest vector display can draw about 100000 short vectors in a refresh cycle without flickering

ii. Raster Display Technology

This technology based on television technology was developed in early 70s

It consists of central processing unit, a video controller, a monitor, system memory and peripheral devices such as mouse and keyboard.

The application program and graphics subroutine package both reside in the system memory and execute on CPU.



When a particular command such as a `line(x1,y1,x2,y2)` is called by the application program the graphics subroutine package sets the appropriate pixels in the *frame buffer*, a portion of the system memory

The *video controller* then cycles thru the frame buffer, one scan line at a time typically 50 times per second.

It brings a value of each pixel contained in the buffer and uses it to control the intensity of the CRT electron beam.

So there exists a one to one relationship between the pixel in the frame buffer and that on the CRT screen

A 640 pixels by 480 lines is an example of *medium resolution* raster display

A 1600 by 1200 is a *high resolution* one

A pixel in a frame buffer may be represented by one bit as in monochromatic system where each pixel on CRT screen is either on '1' or off '0'

Or it may be represented by eight bits resulting 2^8 = 256 gray levels for continuous shades of gray on CRT screen

In color system each of the three color red, green and blue is represented by eight bits producing 2^{24} = 16 million colors

A medium resolution color display having 640 x 480 pixels will thus require (640 x 480 x 24) / 8 = 9kb of RAM

Advantages

i. It has an ability to fill the areas with solid colors or patterns

ii. The time required for refreshing is independent of the complexity of the image

iii. Low cost

Disadvantages

i. For Real-Time dynamics not only the end points are required to move but all the pixels in between the moved end points have to be scan converted with appropriate algorithms Which might slow down the dynamic process

ii. Due to scan conversion "*jaggies*" or "*stair-casing*" are unavoidable