Computer Graphics

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*Introduction

(1) Pixel :- Smallest element, simple element or smallest unit

↳ no. of pixels in a display is calculated by multiplying the height of grid by the width.

↳ For Eg. 1920 * 1080 display, there are a total of 2,073,600 pixel

(2) Types of pixel :- ① Subpixel → subdivision of pixel that is used to show amount of red, green or blue at a location

② Megapixel - is equal to the 1 million regular pixels.

* Digital Images - electoonic snapshots taken of a screen or scanned from documents. Image is sampled and mapped as a grid of dots or picture elements (pixels). Each pixel is assigned a value (black, white, shades of gray or color), which is represented in binary digit (zeros and ones

(3) Bits per pixel (BPP)

↳ denotes no. of bits per pixel and the no. depends on the depth of color or BPP.

1 bpp = 2^1 colors.

2 bpp = 2*2 colors and so on.

∴ no. of color = 2 ^ bpp

* Image size depends upon 3 things
  1. No. of rows
  2. No. of columns
  3. No. of bpp

Formula for calculating the image size is:

size of image = rows * cols * bpp

For eg:-

Let rows be 3000, cols = 1687 and bpp = 256

Calculate size of image?

Answer:- 40488000 bits

* Converting 40488000 bits into bytes = 40488000/8

= 5061000 bytes

* Converting 5061000 bytes into kilobytes (KB)

= 5061000 /(2^10)

= 4942 KB

* Converting 4942 KB into megabytes (MB)

= 632625 (2^10)

= 4 MB

(4) Resolution : W X H

↓ width

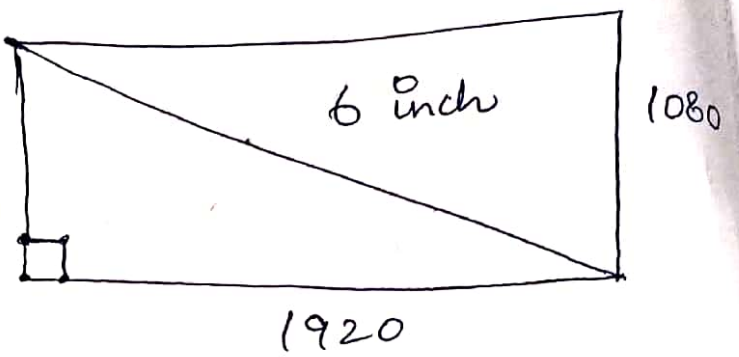
→ Height

Let's take W = 1920

H = 1080

Then (1920 x 1080) is Resolution

⑤ PPI (No. of pixels per Inch)



Calculate the PPI by using pythagorus theorem

$$h^2 = \sqrt{(1080)^2 + (1920)^2}$$

$$= \sqrt{1166440 + 3686400}$$

$$= \sqrt{4852800}$$

$$= 2202.91$$

$$\text{No. of pixel per inch} = \frac{2202.91}{6}$$

$$= 367 \text{ PPI}$$

⑥ Aspect Ratio :- Ratio b/w height and width of an image.

$$= \frac{W}{H}$$

$$AR = \frac{\text{No. of pixel Horizontally}}{\text{No. of pixel Vertically}}$$

Common AR : (4:3), (5:4)

(7) **Frame Buffer :-** Store color values of each pixel

* For TV → in Register
* For computer → in RAM

→ It is typically 2D array of bytes or words.

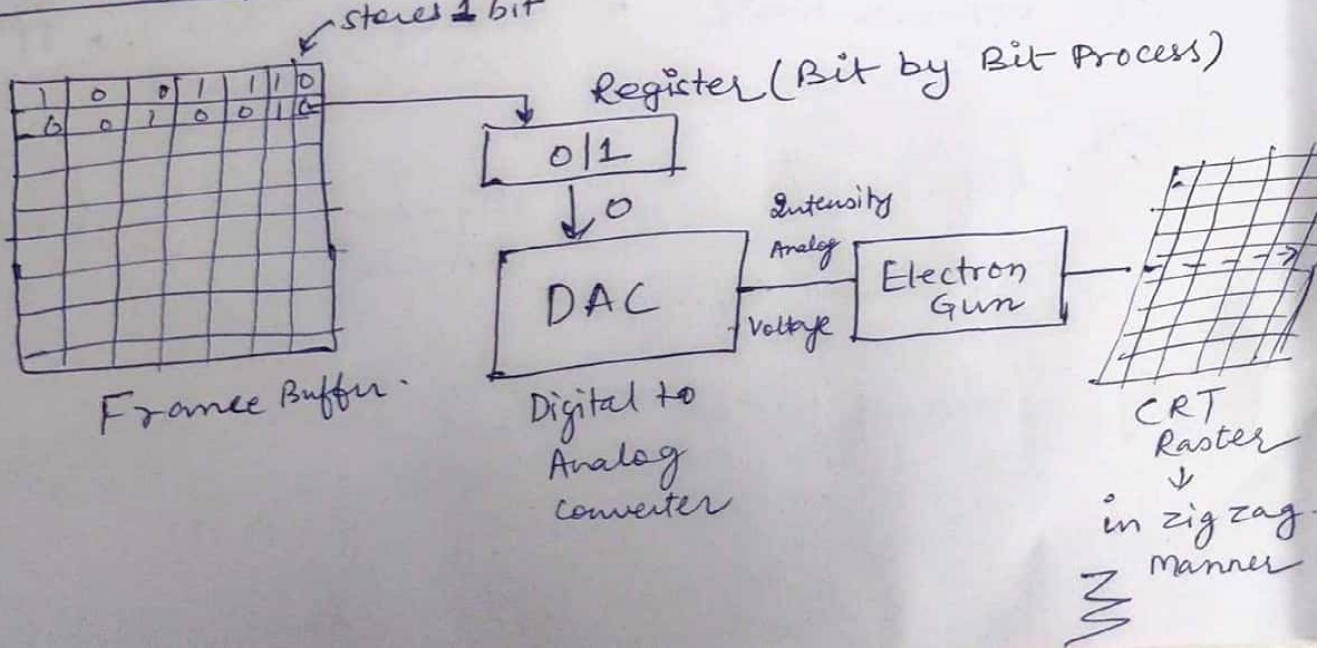
→ each element represent the color of single pixel.

→ No. of shades available on screen is :

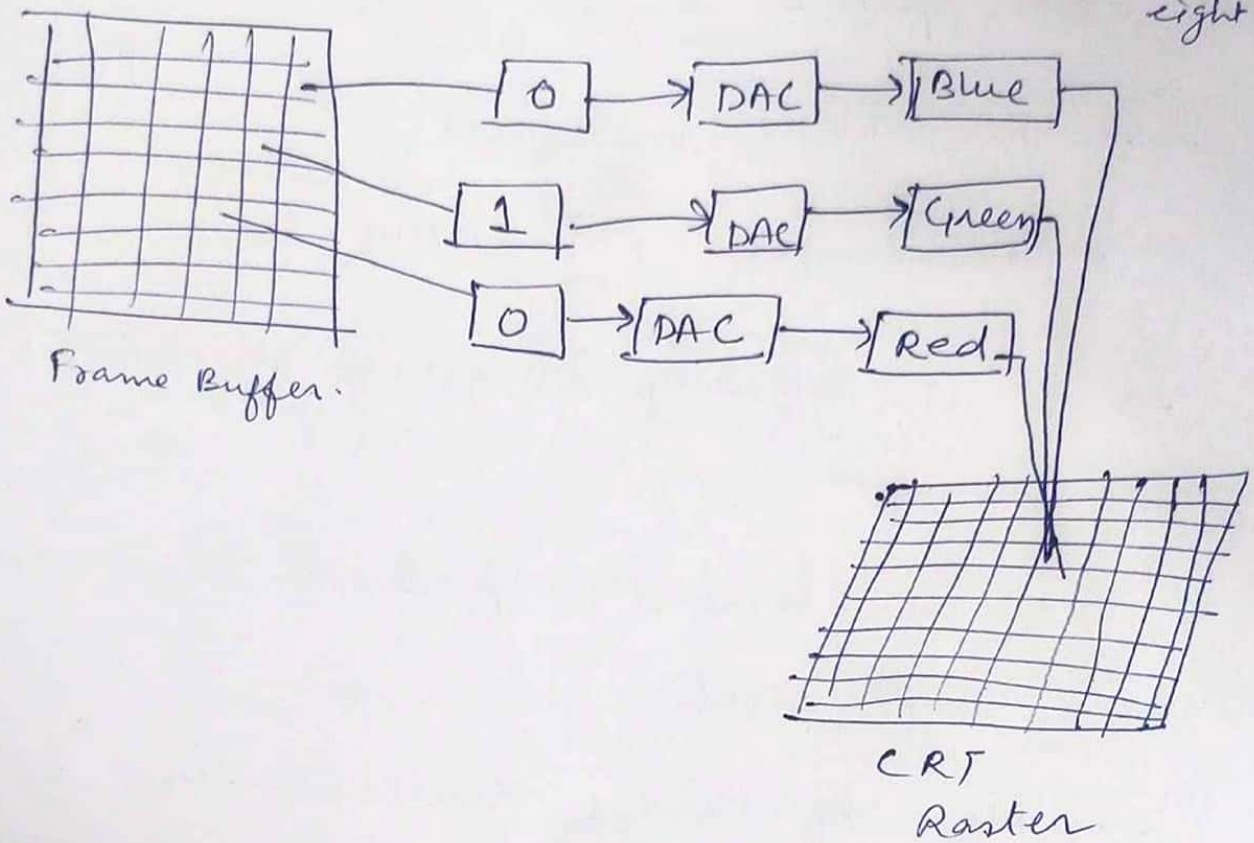
$$\text{Shades} = 2^N$$

where 'N' is no. of Frame Buff

*** Working of Frame Buffer :**



Simple Color Buffer :- (RGB) → primary colors
↳ combine in CRT to yield eight colors



Terminology.

		Meaning	Units
①	Pixel →	a screenpoint	pixels
②	Resolution →	no. of pixel in frame or screen	(x*y) pixels
③	Aspect Ratio →	width : Height	inches
④	Refresh Rate :	No. of frames in sec	→ fps or Hz
⑤	Refresh / Frame Buffer :	Memory Area	Bits or Bytes
⑥	Area of pixel :	Pixel as a circle	πr^2

Ques1 Consider a screen 1024 × 512 pixel resolution. If the refresh rate is 60 frames / sec. How much time would be taken to display one row of pixels.

Soln

60 frames ⇒ 1 sec

1 frame = 1/60 = 0.01675 second

1024 × 512 pixel take 0.01675 second

One pixel takes $\frac{0.01675}{(1024 \times 512)\,s} = 3.18 \times 10^{-8}$

$= 0.318 \times 10^{-9}$

$= 0.318$ ns

Now, one row contains 1024 pixels.

∴ 1 row takes 1024 × 0.318 ns.

= 325.632 ns

Ques Let the resolution of the screen be 1024 x 512. The dimensions of the screen are 12 inches wide and 9.5 inches high. Find the radius of each pixel.

Sol^{n} Total Dimensions = 12 x 9.5 inch

Total no. of pixels = 1024 x 512

Area of each pixel = $\frac{\text{Total Dimension}}{\text{Total Pixel}}$

$\pi r^2 = \frac{12 \times 9.5}{1024 \times 512}$

$\therefore r = \sqrt{\frac{12 \times 9.5}{1024 \times 512 \times \pi}}$

Ques Consider two different raster system with resolution 640 x 480 and 1280 x 1024. What size frame buffer (in bytes) is needed for each of these systems to 12 bits per pixels.

Remarks – Total no. of allowed color is $(2^N) = (2^{12})$

Sol^{n} Screen 1

Total pixels = 640 * 480

Each pixels required = 12 bits

Frame Buffer size = $\frac{(640 * 480 * 12)}{8}$

= 460800 bytes

Screen 2

Total pixels = 1280 x 1024

Each pixels Required = 12 bits

Frame Buffer Size = $\frac{1280 \times 1024 \times 12}{8}$

= 1966080 bytes