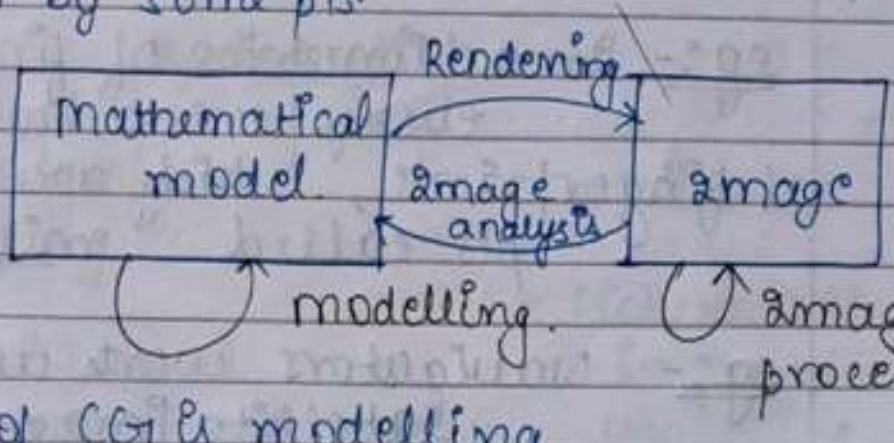
Computer Graphics

→ First we need to create model for an image which can be represented either by eqn or by some pts.



One aspect of CG is modelling.

creation of various models

To convert a model into image → Rendering

covers aspects of covering color, texture, lighting effects, shadows etc.

not a part of model.

- Rendering is also called "Image Synthesis."
- Modification in image → Image processing.

  Aspect of Image processing is Image enhancement.
- If from an Image, we can get some useful info, then it is called Image analysis.

pattern recogonition.

identifying certain common features from a given image.

eg:- In a biometrics of fingerprint every person has diff. fingerprints, which are made up of pts called "minutae".

eg:- Navigators work with help of satellite images which closely matches with images of confusted traffic & free places.

* Graphics → deals with models and converting it into images.

also deals with interaction.

eg:- Analysis used in stock markets.

image analysis/ Visualization.

- Computer Vision-

↓

Includes rendering, image analysis, pattern recogonition.

how are graphical devices (keyboard, mouse) are used to output images (plotter, printer).

Interaction

- Random/ Vector/ Calligraphy

- all images displayed on screen are stored in form of line drawing commands.

- The memory area is known as frame buffer.)

The controller takes image & displays it here, on screen.

- eg:- a landscape will be drawn in form of lines in frame buffer.

- similar to MS logo.

- realistic images/ curves are

- Raster

- Picture is stored in smallest unit i.e pixels.

- entire screen is considered as a rectangular grid of pixels

- Frame buffer stores value of each pixel.

- The controller picks up each pixel value & displays on screen

- Each value is converted into pixels.

Scan conversion

not very smooth.
Thus, generally used in architectural drawings.

- less commonly used as they are expensive

In terms of hardware & not efficiency.

- size of line drawing commands depends on complexity of image.
Also, takes a lot of time.

- colors & patterns to be drawn are much difficult as compared to raster graphics.

- for a resolution of 100 X 100 frame buffer size is 100X100 and thus it stores each pixel value

Scan conversion

To draw a line, we need to find out what pts. lie on line & what are pixel pts in the background (same technique as used to draw lines on graph)

Given 2 pts, first we find slope and they either by incrementing / decrementing we find pixels & then this would be send as foreground colour.

additional thing in raster graphics.
Done by the software

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→ Primitives to be drawn ↓

① Line ② Circle ③ Ellipse.

NOTE:- Size of frame buffer is same as no. of pixels, no role of complex image
But time can vary.

We will deal with Raster Graphics & we have algos. for scan conversion.

• Drawbacks of Raster Graphics ↓

* aliasing / Staircase effect / Jagging :-

When we represent an image in form of pixels, if pixels are close to each other then we get a better image.
But if pixels are seen far apart, that means the resolution of screen is poor.
& is called jagging.

↓

→ To reduce this effect, we have anti-aliasing techniques.

Resolution - The screen is divided into no. of rows of pixels called scan lines.

∴ Resolution = no. of scan lines X no. of pixels on each scan line.

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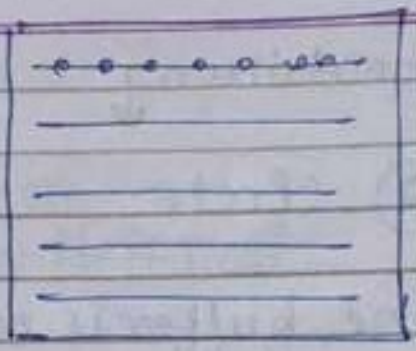
eg:-



200 scan lines & 100 pixels on each line

$= 200 \times 100$

- Aspect Ratio (related to display) — these pixels are W/O overlapping.

~~If no. of~~ How many pixels of vertical scan lines & horizontal scan lines are req. to be plotted to make lines of equal length.

If no. of vertical lines = no. of horizontal lines
↓
aspect ratio = 1

{Otherwise aspect ratio changes}

NOTE:- no. of pixels reqd. vertically to make a line of 1 inch is diff. from no. of pixels req horizontally to make a line of 1 inch.

→ aspect ratio → $\frac{3}{4}$ → Vertical (or 3:4)

{representation may vary}

3 pixels vertically and 4 pixels horizontally are req. to make line of equal length.

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NOTE: In an ideal situation, aspect ratio is 1.

- Persistence - (related to screen/display). The basic display device to be used
  ↓
  CRT (cathode Ray Tubes)

Coated with phosphor material. To display a pixel on screen, e^- are used which strike on phosphor. This raises energy of phosphor & light is emitted which appears as a pixel. which disappears after a given time.
↓
∴ The property of phosphor to persist to $\frac{1}{10}$ th of its intensity is persistence.

If persistence ↑

Refresh rate → how many times pixels take to refresh again per sec. / how many times frame buffer appears on sec.

If persistence ↑, refresh rate ↓es.
If persistence ↓, " " ↑es.

Interlacing - image is in form of frame buffer which has set of values.

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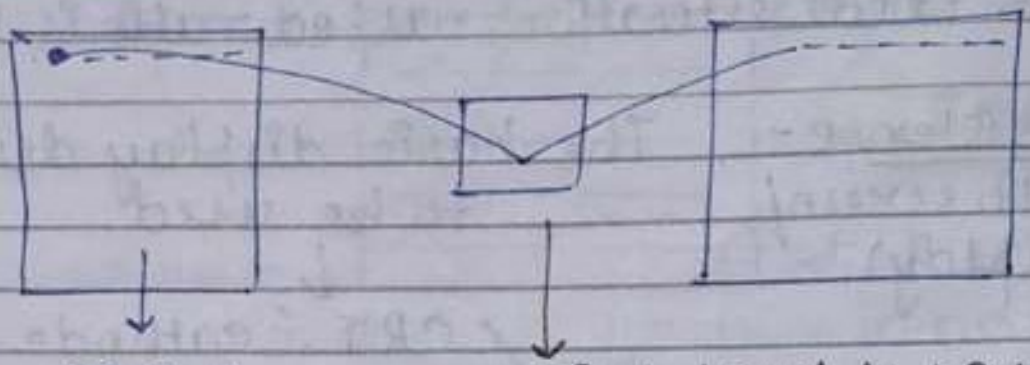


Digital. First pixel is picked up and displayed

When beam moves from the last position of a line to the first position of 2nd line, nothing is printed on screen & this is called "Horizontal Retrace".

Vertical Retrace → no plotting of screen but only pen/ cursor moves from end to first {refresh}.

→ The time taken by vertical & horizontal retrace is very less.

→ Flicker - If monitor is not good, refresh rate is less, we can see a diff. of light & dark spots, called flicker.

↓

To reduce this :-

① Increase refresh rate

⑧ Interlacing (interconnecting)

Plot the alternate scan lines in a given refresh rate, doubling the frame rate and flickering can be reduced & monitors using this technique are "interlaced monitors".

→ These lines are so close together that image does not flicker.

- Types of Display :-

① monochrome - pixels have only single colour. eg - black white monitor.

② Grayscale - If system allows a different shade of grey.
If we want to make a pixel glow, it depends on shade of pixel.

Full power display — white
no " " — black
moderate " " — grey.

If a pixel is stored in only 1 bit, we can have 0 & 1 only.

black & white image.

In a row, m pixels } size of image
" " col, n pixels } m x n.

If for every pixel, we have 3 bits.

↓

∴ 8 values can be stored (0-7)

Thus, we can have 8 shades of grey

0 → 000 → black
1 → 001
2 → 010
⋮
7 → 111 → white

} grey shades

∴ Image size → m x n x 8

∴ 256 shades of grey can be stored.

As we ↑se size of any pixel, size of image ↑ses and thus more shades of grey can be encorporated.

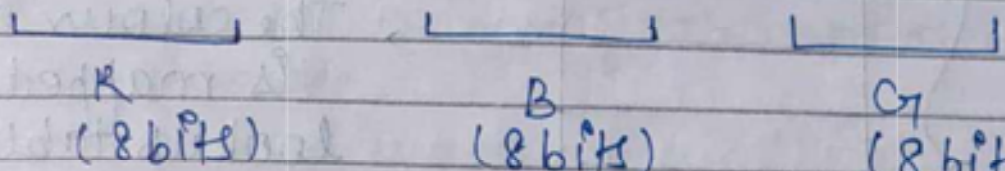
(3) For a coloured image, shades will be divided into

↓

red blue green (rgb)

as they are primary colours

eg:- 24 bit system



→ for pure red pixel

111---1 000--- 000---

blue green

→ for white pixel

all 1's

1111------ 24 times

all blue, red, green get value 1111---

NOTE:- for a colored image on a grayscale monitor, the monitor displays the image but in grayscale.

NOTE:- If system can store 2^{24} pixels but the monitor is not capable of, then we use concept of "lookup tables".

(at hardware level)

If monitor displays less colours but system can store more colour values then we need to match this mismatch.

display device displays — 2^{12} colour

acquired by pixels — 2^{24}.

lookup table (like a palette).

→ The colour of pixel is mapped in the lookup table & we pick up the 12 value & display it.

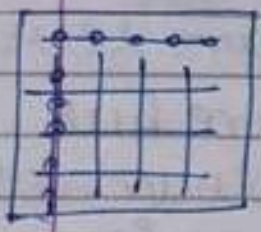
For some other colour, then we map another set of 2^{12} values into table.

* Numericals -

Q1 Find out the aspect Ratio of a Raster System using 8x10 inches screen and 100 pixels per inch.

8 → horizontal
10 → vertical.

$$\therefore \frac{8 \times 100}{10 \times 100} = \frac{8}{10} = \frac{4}{5}$$



{ horizontal scan lines / vertical scan lines }