3 Jan, 19.

{uses mathematical representation}.

Computer Graphics

images, ads, visualization, multimedia, graphs.

→ Image processing (processing of images)

→ Visualization

→ Analysis

→ Computer Vision

→ Computer Graphics - models that can be displayed on the screen.

e.g plotting a line on graph using points.

Formats of images → jpeg, bimap, png.

For images, we have a file of images that consists of a matrix of values that specifies position of image & its colour.

Image processing.

If we process images using models, we call it computer graphics.

eg:- representing boundary of mountain using curve which can be written in a mathematical way.

graphics.h (used to draw primitives)

Including graphics in C++.

→ Computer graphics uses implementing all the graphics functions using models.

→ Transformations can be applied on 2D & 3D primitives using CG. (rotation & translation)

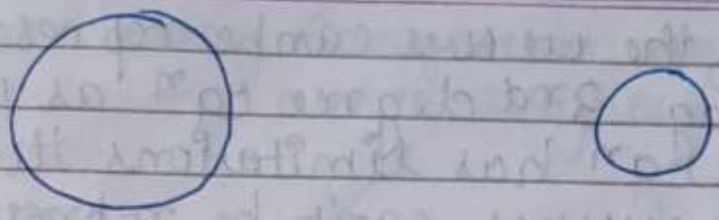
- Computer graphics req. 3 things- (Fields of CG)

(1) Modeling (starting & ending pt. of a line)
(2) Rendering → (how a surface is stored. The data str. can be a mesh, pixel position)
(3) Interaction.

Classes of CG

For a 3D figure (cuboid) → models can be l, b, h, origin (0,0,0)

→ for 3D fig. (sphere) → orientation ✓ circle (2D) → orientation ✗



The 3D figures are first stored in a form of wiremesh.

polygon mesh (entire 3-D surface is divided in set of polygons).

Basically a Δ'r mesh

coordinates present on surface.

* model of 3D surface :-
  - (1) set of small triangles.
  - (2) normal (as normal tells the orientation of a 3D figure).

Methods to represent 3D surfaces

(1) using polygon mesh.

(2) using polynomial curve/equation normally 3rd degree.

eqn of Sphere → $x^2 + y^2 + z^2 = a^2$

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NOTE:- Most of the curves can be represented using 3rd degree eqn as using quad. eqn has limitations that all eqn curves can't be represented.

- Rendering - (1) converting a model into an image.

(2) After that, including colours, depth, shadow and all.

Rendering

Photo realistic rendering

- creating an image of real time.
- rendering image in a way that it looks real.

non photo realistic rendering.

- every image has a boundary around it eg:- cartoons.
- these effects are generated.

- Animations - can be in form of motion or applying forces on an obj. & changing shapes.

- Interaction - Interaction with user and images using graphical devices.

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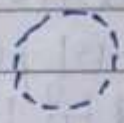
→ We display images on monitor, which are of 2 types (screen)

(used to draw smooth lines).

Vector scan Systems / Random graphics.

- They are also known as calligraphic displays.
- Algorithms / techniques used to draw an image is with help of smooth lines.

eg:- To draw a circle.



→ drawing small line segments.

- Colour done will also be in terms of line segments.
- Image is converted into algo. which consists of lines.
- It is difficult to display realistic pictures.

Raster Scan systems.

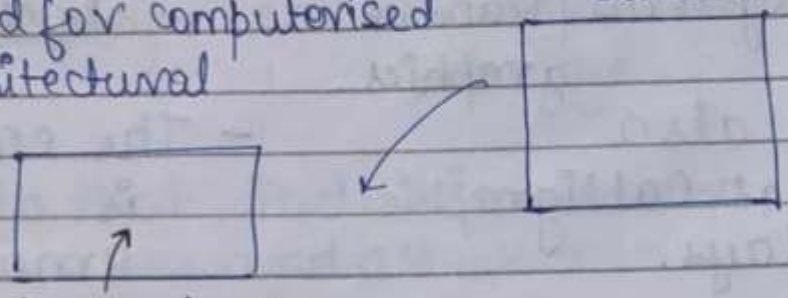
- The entire screen is divided into small units known as pixels.
- The frame buffer here stores entire screen which consists of color of each pixel position.

{pixel}

frame buffer

- More CPU & memory efficient
- may req. more space.

- used for computerised architectural designs. (CAD's)

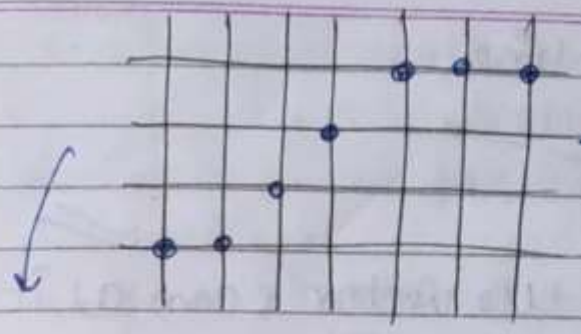


(memory area which stores the image to be displayed on screen)

- frame buffer in ~~b~~ vector scan consists of algo. of lines for drawing image.
- req. more time as the primitive/ image has to be converted into a set of points. (we need to find all the pts. lying on a line)

Algorithms used to find pts. lying on a line using start & final pts. Is Raster scan algorithms.

On screen, these pts. will be drawn & not the complete figure.



Screen display in Raster graphics.

Here, if resolution of screen i.e dist. b/w pts. is less then it appears as an image rather than pts.

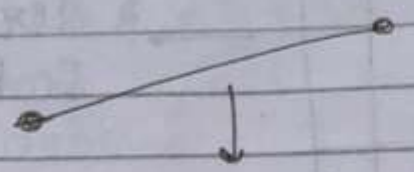
→ If resolution is less, it appears as pts. (Jagged images)

- In vector scan, geometric images are drawn better.
- In raster scan realistic pictures can be drawn better.
- efficiency depends on complexity of scene.
- inexpensive.
- Used for coloured images & filling of patterns.
- no matter screen is simple or complex, time for refresh is same as same pts. are plotted.

NOTE:- The hardware displays every picture multiple times (60) in 1 sec. So that image doesn't fade. (Refresh).

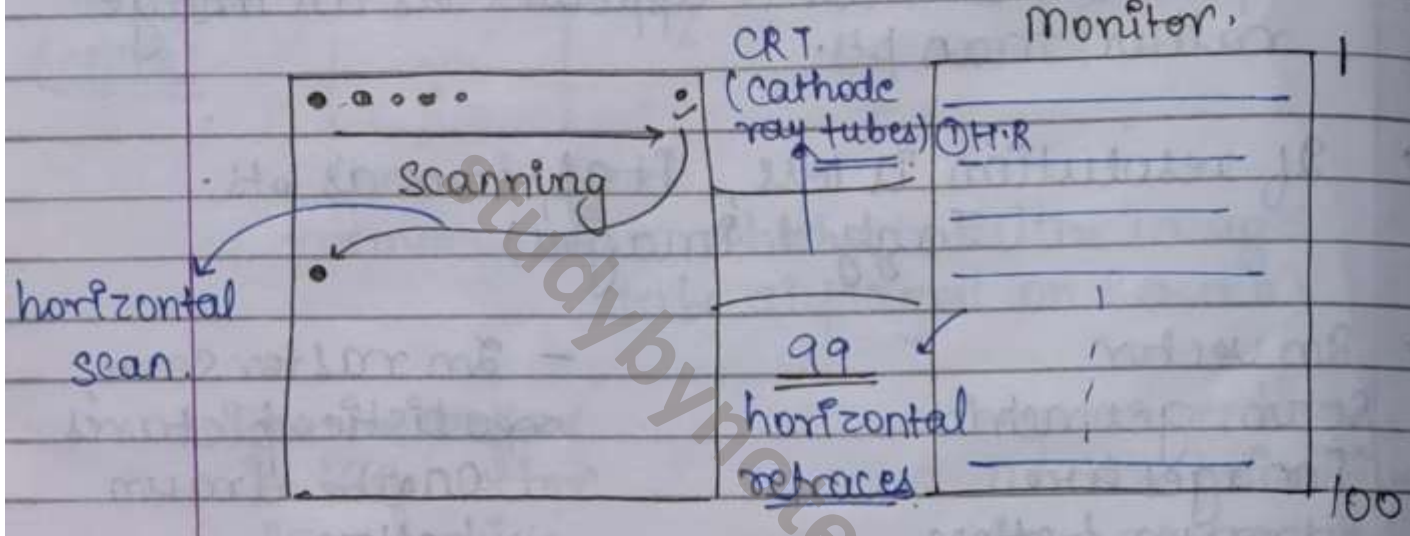
- Image in frame buffer must be refreshed again & again.

eg:- To draw a line



Use vector scan as it is fast.

Here, if we use raster scan we need to find all pts. on line & plot them.



The time when the last point of a line is done & we come to next line, it is called retracing.

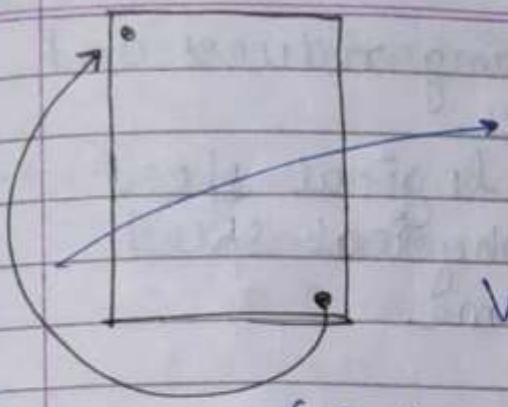
↓

If retracing time is more,

- Frames per sec - no. of frames displayed per second.
(Refresh rate)

→ 99 horizontal retraces req. for 1 frame.
Speed → 60 frames/s

∴ 99 × 60



vertical retrace when we return from final position to initial position.

Vertical retrace occurs when we refresh our page to again start process

60 frames/s

59 vertical retraces occur, as once the frame is present.

for a screen of 100 X 100 & frame/s = 60.

horizontal retraces → 99

vertical retraces → 59

NOTE:- If frame rate is not good, we get an effect of flicker.

To improve this, increase frame speed.

- Interlacing - When we draw a figure, we draw in parts by first taking half of the lines and lines are so closely placed that no such effect occurs

(Technique to reduce flickering)

(1) plot odd no. lines
(2) plot even " "

This is useful as fading reduces and also time reduces.

So, we have increased logical speed while keeping physical speed same.