PAGE NO :
DATE : 18 / Jan / 2019

UNIT - 1

* **Computer Graphics** – Computer graphics is an art of drawing lines, pictures, chart etc using computers with the help of programming. Computer graphics is made up of number of pixels. Pixel is the smallest graphical picture or unit represented on the computer screen.

A graphic is an image or visual representation of an object, therefore computer graphics are simplify image display on a computer screen. Graphics are often with text, which is compromise of characters, such as numbers and letters rather than image.

Computer graphics can be either 2-dimensional or 3-dimensional. 2-D graphics comes in two way –

1- Vector graphics
2- Raster graphics

Raster graphics – Raster graphic are the most common and are used for digital photo, web graphics, icons and

other type of image. They are composed of a simple grid of pixels which can in different colour.

Vector graphics – Vector graphics on the other hand are made of paths which may be lines, shapes, letters or other scalable object.

* Interactive Graphics – A computer graphics system that allow the operator to interact with the graphical information presented on the display using one or more of a number of input devices, some of interactive graphics which are aimed at delivering positions relevent to the information being displayed.

* Advantage of interactive computer graphics –

1. Graphics provide one of the most natural means of communicating with a computer, since our highly developed 2-D and 3-D pattern recognition ability allow us to

PAGE NO:
DATE: / /

recieve and process on pictorial data rapidly and effectively.

2. In many design, implementation and construction processing, today the pictures can give responsible information.

3. Creating and reproduce pictures, presented technical problems that stood easy way and interactive computer graphics.

4. Easy to understand.
5. Easy / Simple design.
6. Faster communication
7. Effective result
8. Best solution

* Representative use of computer graphics -

1- User interface - With the help of computer graphics we can create GUI (Graphical User Interface) based.

2- Business, science and technology - In modern days, the use of computer

PAGE NO :
DATE : / /

graphics is in every field of science, technology and business also. With the help of computer graphics we can create pictograph, bar and pie-charts.

3- Computer aided design (CAD) — CAD used for design the structure of any kind of model - buildings, automobile bodies.

4. Simulation and animation — Simulation and animation is used for scientific visualization and entertainment. Some examples of simulation and animation are - flight, games, movies, virtual reality

5- Art and commerce — The use of computer graphics is in art and commerce to find the average design of any kind of information like - terminall of public place like- museum, hotels, shops etc.

PAGE NO: 12
DATE: / /

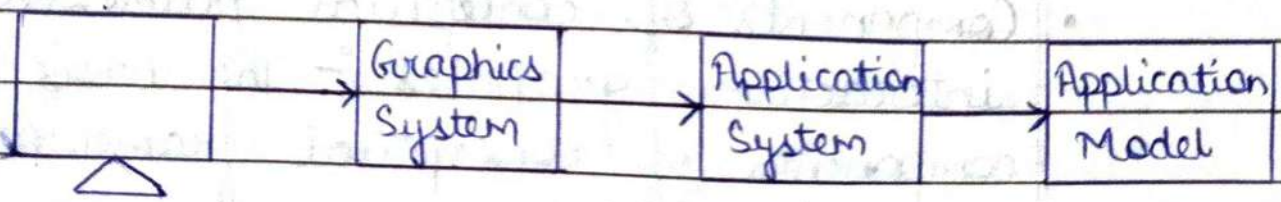
* **Desktop publishing** – Desktop publishing is the use of a computer to produce high quality documents containing text and graphics formatted for a single-page publication.

Example – Desktop publishing is utilized to create printed material such as book covers, brouchure and fliers.

Desktop publishing software can generate layouts and produce typographic quality text and images. Some of the desktop publishing softwares are – Adobe framemaker, Adobe photoshop, Adobe illustrator, Coreldraw etc.

There are two types of pages in desktop publishing – electronic pages and virtual paper pages to be printed on physical paper pages.

* **Conceptual framework of Interactive Graphics** :-



PAGE NO :
DATE : / /

- **Framework** — In computer graphics, a framework is a layered structure indicating what kind of program can or should be built and how they would be interrelate.
Some computer graphics system framework also include actual program, specify programming interface or offer programming tools for using the framework.

- **Conceptual framework of Interactive graphics** — Conceptual framework compromise of concepts and ideas that are organised and manner in such a way that make communication between graphics application and user with smoothly. It is an organised form of thinking for completing project according to the demand of user and fulfil all the requirements which are demanded by user.

- **Components of conceptual framework of interactive graphics** :- The basic components of conceptual framework are given below -

PAGE NO :
DATE : / /

1- Graphics library — Graphics library helps between application and displaying hardware (which used to show graphics model).

2- Application program — An application program maps all applications objects to image by invoking graphics.

3- Graphics system — An interface that interact between graphics library and hardware.

* Scan conversation :- Scan conversation is a concept of to calculate the specify slope of any of segment. Scan conversation convert the graphical object according to the needs of user. There are two types of scan conversation —

1. Raster graphics
2. Random (vector) graphics

1. Raster graphics scanning — The raster scan is a scanning technique in graphics monitor where the electron's beam is moved along the scan which screen covering one line at a time from top to bottom. The beam is set as high

PAGE NO :
DATE : / /

and low level as the beam swept around the screen to generate the pattern of illustrate spots. The fundamental unit of raster graphics is known as pixel.

2. Random scanning or vector graphics – Random scanning work in a completely different manner to raster graphics where the electron beam is pointed to merely those area of screen where the picture is to be drawn. However it only involve one line at a time when join a picture that is also known as vector graphics. The electron beam is made to point only toward the part of the screen where the picture is to be drawn.

- Difference between Raster graphics and vector graphics scan (display)

Basis of comparision	Raster scan	Random scan
1- Electron beam	Swept across the screen and hande one row at a	Directed to the portion of the screen where a picture

PAGE NO:
DATE: / /

		time and in downward direction	is to be spot.
2-	Resolution	Poor, since it generate lines which are organised as point sets.	Good, as this produce even line drawing.
3-	Picture definition	Store as the combination of intensity values of all screen points.	Store as a group of line drawing instruction in a display file.
4-	Realistic display	Effectively raster scan show the realistic display.	Unable to display realistic but display the shaded display.
5-	Picture rendering (Basic unit)	Raster scan uses the pixels.	With the help of mathematical functions, show the raster scan display.

PAGE NO :
DATE : / /

* **DDA Algorithm** – In computer graphics a digital differential analyzer (DDA) is hardware or software used for interpolation of variables over an interval between start and end point. DDA's are used for rasterization of lines, triangles and polygons.

Digital Differential Analyzer (DDA) algorithm is the simple line generation algorithm which is explained step by step here –

Step 1– Get the input of two end points (X_0, Y_0) and (X_1, Y_1).

Step 2– Calculate the difference between two end points.

$$d_x = X_1 - X_0$$
$$d_y = Y_1 - Y_0$$

Step 3– Based on the calculated difference in step 2, you need to identify the number of steps to put pixel. If $dx > dy$, then you need more steps in x coordinate, otherwise in y coordinate.

```
if (absolute(dx) > absolute(dy))
    steps = absolute(dx);
else
```

PAGE NO:
DATE: / /

steps = absolute(dy);

Step4- Calculate the increment in x coordinate and y coordinate.

```
x increment = dx/(float) steps;
y increment = dy/(float) steps;
```

Step5- Put the pixel by successfully incrementing x and y coordinate accordingly and complete the drawing of the line.

```
for(int v=0; v<steps; v++)
{
    x = x + X increment;
    y = y + Y increment;
    putpixel(Round(x), Round(y));
}
```

* Bresenham's Line generation –

The Bresenham's algorithm is another incremental scan conversion algorithm. The big advantage of this algorithm is that, it uses only integer calculations. Moving across the x axis in unit intervals and at each step choose between two different y coordinates.

Step1- Input the two end-points of line, storing the left end point in (x_0, y_0).

Step2- Plot the point (x_0, y_0).

Step3- Calculate the constants dx, dy, 2dy and

PAGE NO :
DATE : / /

$(2dy - 2dx)$ and get the first value for the decision parameter as -

$$P_0 = 2dy - dx$$

Step 4- At each x_k along the line, starting at $k=0$, perform the following test -

If $P_k < 0$, the next point to plot is $(x_k + 1, y_k)$ and

$$P_{k+1} = P_k + 2dy$$

Otherwise,

$$(x_k, y_k + 1)$$

$$P_{k+1} = P_k + 2dy - 2dx$$

Step 5- Repeat step 4 $(dx - 1)$ times.

For $m > 1$, find out whether you need to increment x while incrementing y each time.

After solving, the equation for decision parameter P_k will be very similar, just the x and y in the equation gets interchanged.

* **Scan converting line :-**

DDA algorithm - The goal of any line drawing or scan is to construct the best possible approxim

PAGE NO:
DATE: 29/Jan/2019

-tion of an ideal line given limitation of a raster display.

DDA algorithm is an incremental scan conversion method. Here we perform calculation at each step using the result from the previous step. The characteristics of the DDA algorithm to take unit step along one coordinate and compute the corresponding values along the other coordinate.

DDA algorithm is a scan conversation line algorithm based on the calculating Δx and Δy.

where $\Delta x = x_2 - x_1$ and $\Delta y = y_2 - y_1$.

The basic formula of DDA algorithm is -

$$\text{slope}(M) = \frac{y_{end} - y_{start}}{x_{end} - x_{start}}$$

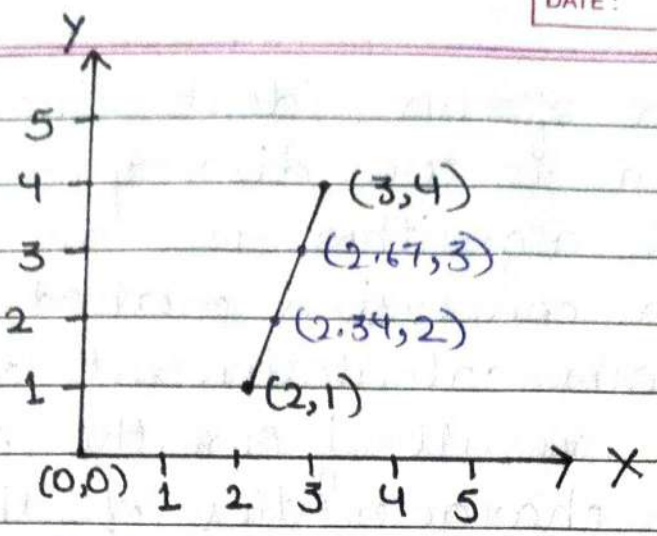
There are 3 possible values of M.-

M	x_{k+1}	y_{k+1}
$M < 1$	$x_{k+1} = x_k + 1$	$y_{k+1} = y_k + M$
$M = 1$	$x_{k+1} = x_k + 1$	$y_{k+1} = y_k + 1$
$M > 1$	$x_{k+1} = x_k + \frac{1}{M}$	$y_{k+1} = y_k + 1$

where k = next co-ordinate

PAGE NO :
DATE : / /

Exc-



$\text{slope}(M) = \frac{4-1}{3-2} = 3$

$x_{k+1} = 2 + \frac{1}{3}$ $\quad (x=2, y=1)$

$= \frac{6+1}{3} = \frac{7}{3} = 2.34$

$y_{k+1} = 1+1 = 2$

$\text{slope}(M) = \frac{4-2}{3-2.34}$

$= \frac{2}{0.66} = 3.03$

$x_{k+1} = 2.34 + \frac{1}{3.03}$

$= 2.67$

$y_{k+1} = 2+1$

$= 3$

PAGE NO :
DATE : 30 / Jan / 2019

★ Scan converting circle :- Converting the unbroken graphical object as a group of objects is called scan conversion. In the process of scan converting of a circle, the circle is divided into 8 equal parts from the centre point of the circle. One part is called octant and if one part is generated then it is easy to scan the other seven parts. So computing the one octant it is enough to determine (scan) the other parts also.

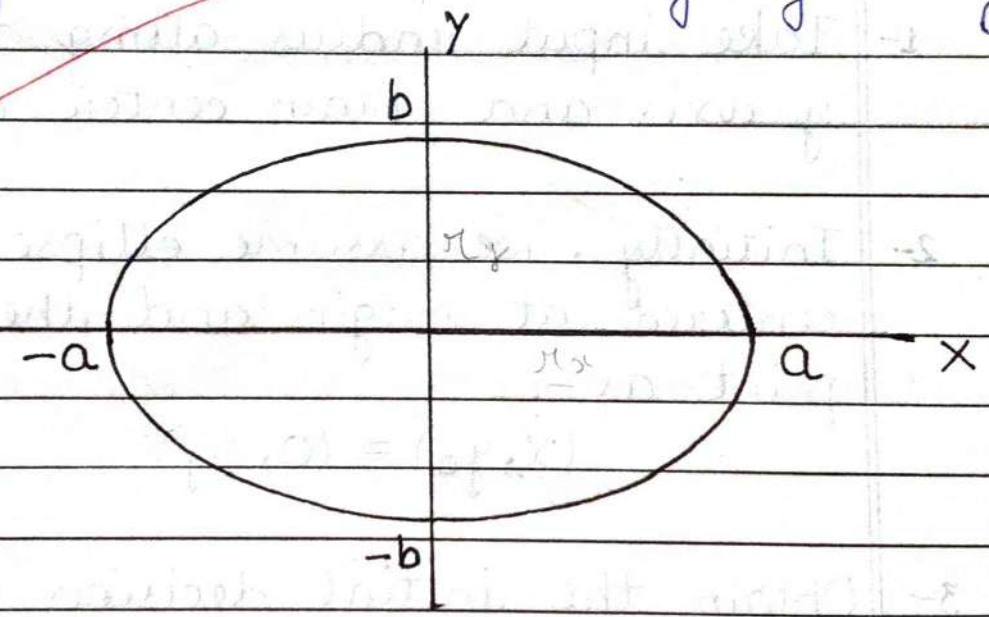
Techniques use to compute octant – There are several types of techniques or method in scan converting circle is given below

1- DDA algorithm
2- Direct or polygon approach
3- Parametric and trignometric approach.
4- Bresenham's algorithm
5- Mid point circle algorithm

PAGE NO:
DATE: / /

Scan Converting Ellipse

Mid-point ellipse algorithm is used to draw an ellipse in computer graphics. Midpoint ellipse algorithm plots points of an ellipse on the first quardrant by dividing the quardrant into two regions. Each point (x,y) is then projected into other three quardrants $(-x,y)$, $(x,-y)$, $(-x,-y)$ i.e., it uses 4-way symmetry.



$$F(X,Y) = b^2X^2 + a^2Y^2 - a^2b^2 = 0$$

If you draw only the points of the first quardrant then by symmetry you can obtain the other three quardrants.

PAGE NO :
DATE : / /

Decision parameter –

Initially, we have two decision parameters $p1_0$ in region 1 and $p2_0$ in region 2.
These parameters are defined as: $p1_0$ in region 1 is given as:

$$p1_0 = r_y^2 + \frac{1}{4} r_x^2 - r_x^2 r_y$$

Mid-Point Ellipse Algorithm –

1- Take input radius along x axis and y axis and obtain center of ellipse.

2- Initially, we assume ellipse to be centered at origin and the first point as –

$$(x, y_0) = (0, r_y)$$

3- Obtain the initial decision parameter for region 1 as –

$$p1_0 = r_y^2 + 1/4 r_x^2 - r_x^2 r_y$$

4- For every x_k position in region 1:
If $p1_k < 0$ then the next point along is (x_{k+1}, y_k) and

$$p1_{k+1} = p1_k + 2 r_y^2 x_{k+1} - 2 r_x^2 y_{k+1} + r_y^2$$

PAGE NO:
DATE: / /

5- Obtain the initial value in region 2 using the last point (x_0, y_0) of region 1 as:

$$p2_0 = r_y^2(x_0 + 1/2)^2 + r_x^2(y_0 - 1)^2 - r_x^2 r_y^2$$

6- At each y_k in region 2 starting at $k=0$ perform the following type-
If $p2_k < 0$ the next point is (x_k, y_{k+1}) and

$$p2_{k+1} = p2_k - 2r_x^2 y_{k+1} + r_x^2$$

7- Else, the next point is (x_{k+1}, y_{k-1}) and

$$p2_{k+1} = p2_k + 2r_y^2 x_{k+1} - 2r_x^2 y_{k+1} + r_x^2$$

8- Now obtain the symmetric points in the three quardrants and plot the coordinate values as:

$$x = x + x_c, \quad y = y + y_c$$

9- Repeat the steps for region 1 until

$$2r_y^2 x \geq 2r_x^2 y$$

PAGE NO:
DATE: 31 / Jan / 2019

UNIT - 2

Hardcopy Technology

* **Hardcopy Technology :-** There are two broad categories of hardcopy devices :-

1- Printer
2- Plotter

Plotter has limited and specialised use where printer is a common purpose use. Most of the computer graphics creation have their ultimate utilization printed / plotted form that are used for design documentation, exhibition and obligation in books or other print media. So it is the quality of printed / plotted output that make computer graphics application software appealing for their various business purpose.

Objective of hardcopy technology -

1- Understanding the basic printing technology and major category of hardcopy devices with reference to factors that effect the printing / plotter quality.
2- Describing the structure and function of each hardcopy devices.

PAGE NO :
DATE : / /

3- Highlighting the usual application (business) area of each device.
4- Understanding how a computer communicate with state of art printed / plotted.

★ **Printer :-** The printer is an important accessory of any computer system, specially for a computer graphics system. This is because most of graphics creation software uses the hardcopy devices.
Printer helps to utilization in printed form of documentation, publication and exhibition.
Based on the available printing technology, the major factors which control the quality of printer are individually dot-size on the paper and number of dot per-inch (DPI).
There are two types of printers in current printer technology :-
1- Impact printer
2- Non-impact printer

• **Impact printer** — These printers have a mechanism whereby formed characters phases are pressed against

PAGE NO:
DATE: / /

an inked ribbon onto the paper in order to create an image.
The example of impact printer is dot-matrix printer and line printer.

(i) Dot-matrix printer – Dot matrix printers are character printers that print one character at a time. They form characters and all kinds of images as pattern of dots. It produces characters and illustrations by striking pins against an ink ribbon to print closely spaced dots in the appropriate shape.

Advantages –

1. A dot matrix printer is practically cheaper and easily available.
2. Can print carbon copies.
3. Indication of ribbon replacement.

Disadvantages –

1. Output is not high resolution, the color printout is limited while print speed is lesser.
2. Pins can bend easily.
3. Time-consuming and prone to paper jamming.

DATE : / /

(ii) **Line Printer** – Line printer can print one line at a time. The line printer is a form of high speed impact printer. They can print 300 to 3000 lines per minute. So that they are very fast. Large computer system typically use Line printer. They are of two types – Drum printers and chain printers.

Advantages –

They are very fast, the entire line of printer can be struck at once.

Disadvantages –

The standard line printer can only use pin feed paper, cannot use other than standard widths typical. No color other than black.

- **Non-impact printer** – These printer do not touch the paper, rather use a laser technology, ink-spray, zerographics, electronostics methods to produce the image on the paper.

  The example of non-impact printer is laser printer, inkjet printer, electrostic printer, drum-plotter, flatbed plotter.

PAGE NO: .
DATE: / /

(i) Laser Printer – A laser printer uses a laser and electrical charge model instead of traditional printing of ink onto paper. They print the whole page at once. They form characters by very tiny ink particles.

Advantages –

1. Faster compared to inkjet printers
2. Sharp and precise, can print even the smallest detail perfectly.
3. Durable and reliable type of printer.

Disadvantages –

1. Higher overall price
2. No variety of paper allowed, require standard style paper only.
3. Not suitable for printing photos.

(ii) Inkjet Printer – The inkjet technology works by spraying very fine drops of ink on a sheet of paper. Inkjet printers produce printed output as pattern of tiny dots.

Advantages –

1. High quality of output, capable of printing fine and smooth details.
2. Low cost.
3. Capable of printing vivid color, good for printing pictures.
4. Easy to use.

PAGE NO :
DATE : / /

Disadvantages –

1. Print head is less durable.
2. Not good for high volume printing.
3. Ink bleeding, ink carried sideways causing blurred effects on some papers.

(iii) Electrostatic Printer – A printer used to print an optical image on a specially treated paper. Light and dark portions of the original image are illustrated by electrostatically charged and uncharged portions of the paper.

Advantages –

1. Lowest-cost per page.
2. Ability to print multi-page documents.
3. Print up to 5000 lines per minute.

Disadvantages –

1. Very noisy.
2. Slow speed
3. Space consuming

(iv) Drum-plotter – A drum-plotter is a type of printer used to produce graphics such as architechtural blueprints created with CAD applications.

The drum plotter uses a drum to move the paper left and right while one or more pens draw up and down.

PAGE NO:
DATE: / /

Advantages-
Drawings are of the same quality as if an expert drew them.
Disadvantages-
1. More expensive
2. They do not produce very high quality text printouts.

(U) Flatbed plotter - In the flatbed plotter, the paper is fixed on a flat surface while the pens are mentioned to draw the image. This is the plotter which can successfully use several colored pens for the purpose of the effect is different from the regular.
Advantages -
1. Large plotter printers are capable of printing on material which is as large as 60 inches wide.
2. Quality every time, it can reproduce the same template again and again.
Disadvantages-
1. Needs a large space.
2. High price.

PAGE NO :
DATE : / /

* **Plotter :-** In contract to the printer which is primarily are raster scan devices, plotter is a vector printing devices. The microprocessor in the plotter receive the instruction from the host computer and execute commands like move (moving the carriage) to a given position with pens up) and draw (drawing geometric entities like- line, point, circle etc with pen-down) since the plotter is a vector hardcopy devices, it can directly reach specific position on the printer paper without following raster row sequence.
In flatbed plotter the paper lies flat and stationary while the pen move from one location to another location on the plotter but in drum plotter, the paper itself slide on a cylindrical drum and the pen move over the drum.

* **Display Technology :-**
This display medium for computer graphics generated pictures had becomes widely use. Typicaly examples are CRT (Cathod ray tube), LCD, LED, Raster

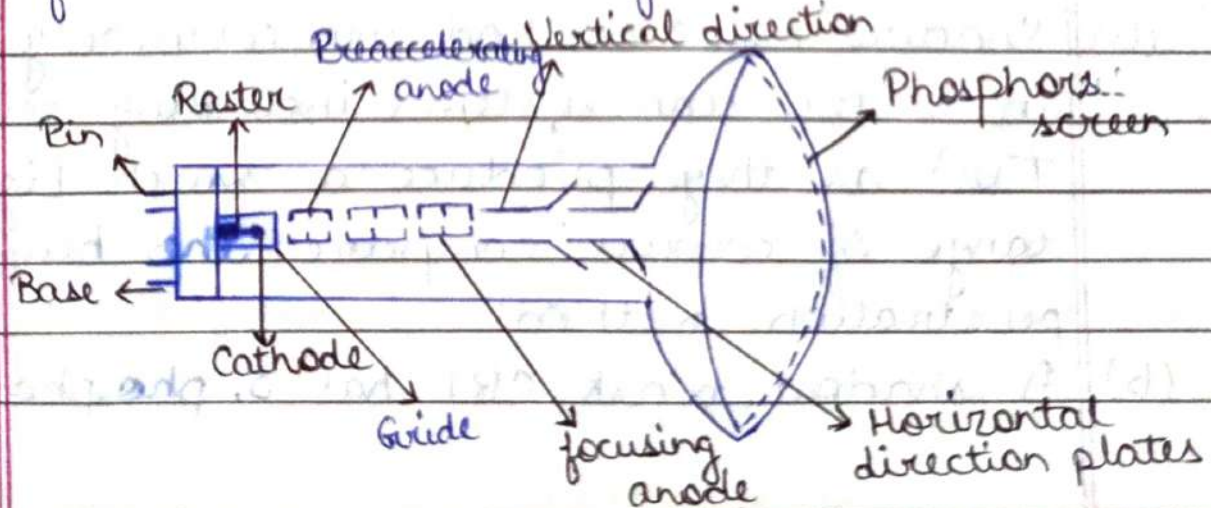
PAGE NO :
DATE : / /

display and Random display.
Most of the basic display fundamental concepts used CRT technology.

* Objective of display technology -

1- Understanding the basic concepts and parameters base on an image and physical display screen.
2- Understanding the basic display concepts employ it in raster scan with reference to the architecture of CRT.
3- Understanding the theory of colours display with reference to graphics memory and CRT and circuitry.
4- Outlining the display system and display technology.

* CRT :- A CRT monitor display colour's picture by using combination of phosphors that emit coloured lights by combining light from the different phosphors, range of colour is to be generated.



PAGE NO :
DATE : / /

There are two methods for producing coloured display with a CRT -

1. Beam Penetration
2. Shadow mask method

1- Beam Penetration Method -

(a) The beam penetration method for displaying colour pictures has been used with random scan monitors.

(b) Two layer of phosphors usually red and green are coated onto the inside of CRT screen and the displayed colour depend on how far the electron beam penterate onto the phosphor layer.

(c) A beam of slow electrons exist only outer red layer and faster electrons contact to inner green layer.

(d) The speed of electrons and hence the screen colour at any point is controlled by beam acceleration voltage.

2- Shadow Mask Method :-

(a) Shadow mask method are commonly used in Raster scan system (including colour T.V.) as they produce a much bigger range of colours compare the beam penetration method.

(b) A shadow mask CRT has 3 phosphors

PAGE NO :
DATE : / /

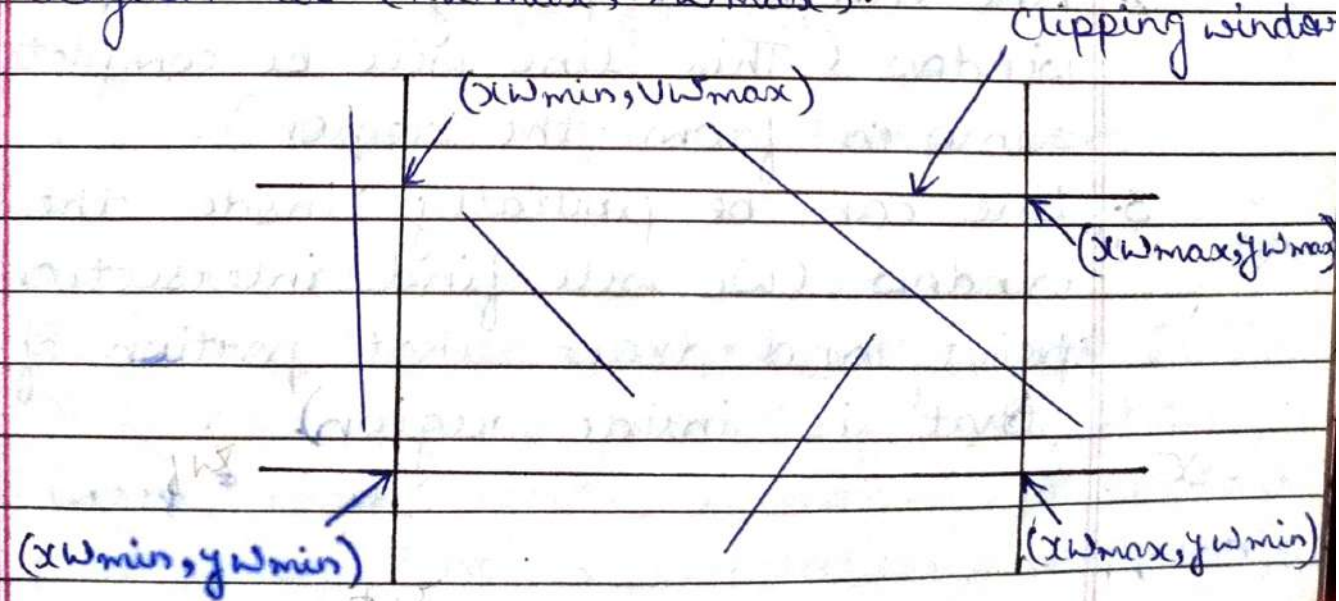
colour dots (red, green, blue) at each pixel position.

(c) One phosphors dot emits a red light. Second phosphors dot emits a green light and third phosphors dot emits a blue light.

(d) Shadow mask display CRT has 3 electrons gun. One for each colour dot and a shadow mask grid just behind the phosphors coated screen.

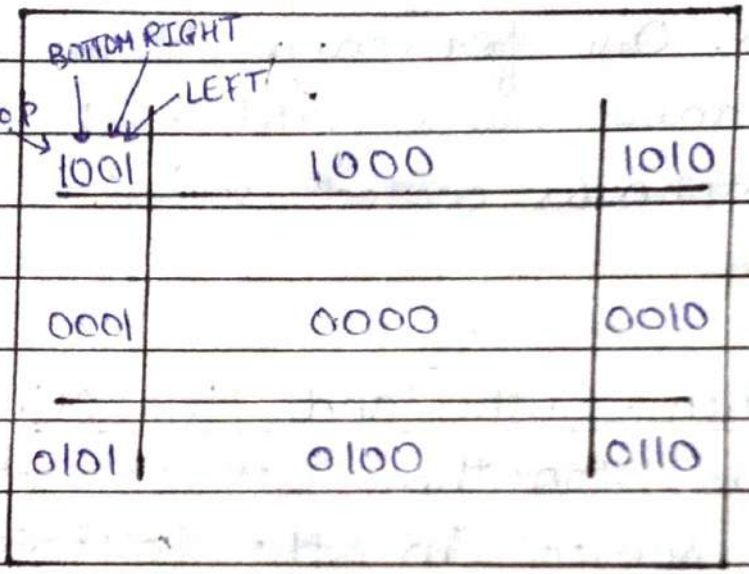
★ **Cohen - Sutherland Line Clippings Algorithm:-**

This algorithm uses the clipping window as shown in the following figure. The minimum coordinate for the clipping region is $(X_{W_{min}}, Y_{W_{min}})$ and the maximum coordinate for the clipping region is $(X_{W_{max}}, Y_{W_{max}})$.



PAGE NO :
DATE : / /

We will use 4-bits to divide the entire region. These 4-bits represent the Top, Bottom, Right and Left of the region as shown in the following figure. Here, the TOP and LEFT bit is set to 1 because it is the TOP-LEFT corner.



There are 3 possibilities for the line-

1. Line can be completely inside the window. (This line should be accepted).
2. Line can be completely outside of the window (This line will be completely removed from the region).
3. Line can be partially inside the window. (We will find intersection point and draw that portion of line that is inside region)

(minus of minus)

PAGE NO :
DATE : / /

Algorithm :-

Step 1- Assign a region code for each end points.

Step 2- If both endpoints have a region code 0000 then accept this line.

Step 3- Else, perform the logical AND operation for both region codes.

(a) If the result is not 0000, then reject the line.

(b) Else you need clipping.

(i) Choose an endpoint of the line that is outside the window.

(ii) Find the intersection point at the window boundary (base on region code).

(iii) Replace endpoint with the intersection point and update the region code.

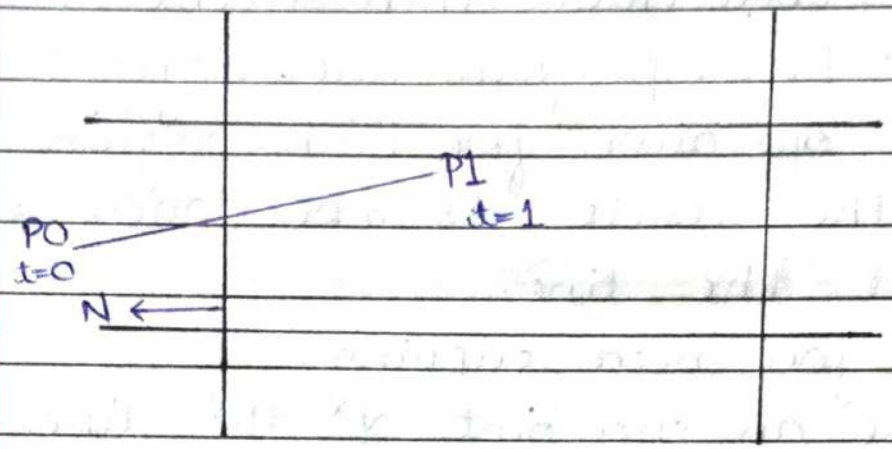
(iv) Repeat step 2 until we find a clipped line either trivially accepted or trivially rejected.

Step 4- Repeat step1 for other lines.

★ **Cyrus-Beck Line Clipping Algorithm :-**
This algorithm is more efficient than Cohen-Sutherland algorithm. It employs parametric line representation and simple dot products.

PAGE NO :
DATE : / /

Cyrus-Beck is a general algorithm and can be used with a polygon clipping window unlike Sutherland-Cohen, which can be used only on a rectangular clipping area.



Here the parametric equation of a line in the view plane is —

$$p(t) = tp_1 + (1-t)p_0$$

where $0 \leq t \leq 1$

Now to find the intersection point with the clipping window we calculate the value of the dot product.

Let p_E be a point on the clipping plane E.

Calculate $n \cdot (p(t) - p_E)$

If < 0, vector pointed towards interior.

If $= 0$, vector pointed parallel to plane containing p.

If > 0, vector pointed away from interior

Here n stands for normal of the current

PAGE NO :
DATE : / /

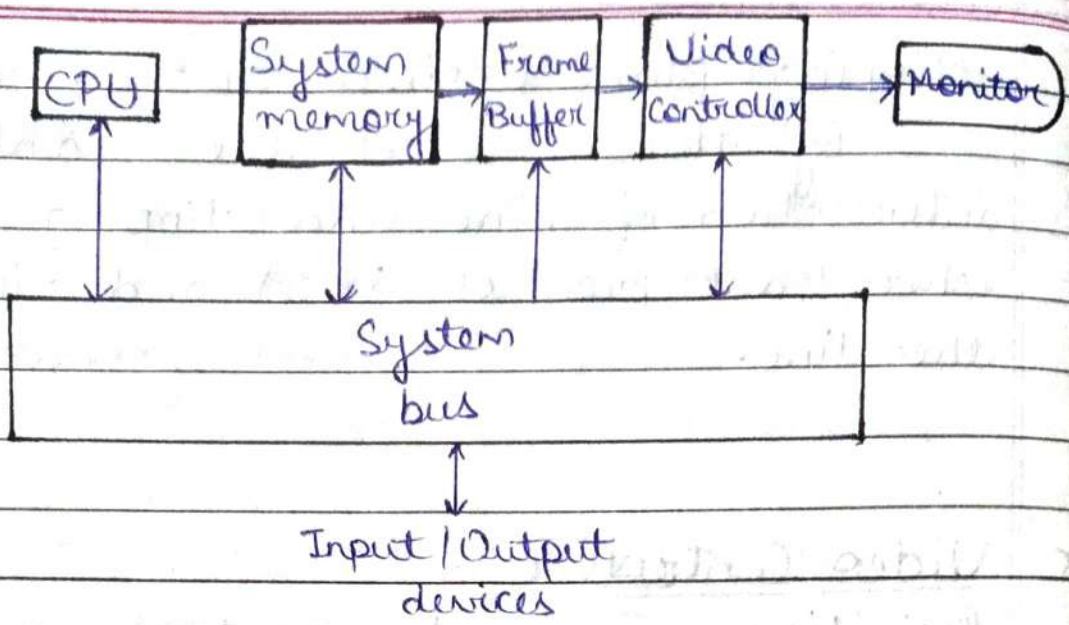
clipping plane (pointed away from interior).
By this we select the point of intersection of line and clipping window where (dot product is 0) and hence clip the line.

* Video Controller :-

Definition - Just like a text, audio and image, digital videos are also a powerful element of multimedia system. To understand how digital video is used as a media we need to understand the fundamental concept (motion, image, audio, text) of video technology.

In Central Processing Unit (CPU) there is a special purpose processor called video controller or display controller. This processor is used to control the operation of display devices. Simply means, a video controller is a processor that is used to control all operations required by display devices.

PAGE NO :
DATE : / /



Architecture of raster graphic system

A fixed area of the system memory is reserved for the framebuffer and video-controller is given direct access to framebuffer memory. Framebuffer location and the corresponding screen position are referenced in a simple raster scan system.

Since the screen must be refresh 60 frames per second. The cycle time is too slow. To speed up pixel processing video controller can retrieve multiple pixels values from the framebuffer.

* Input devices in computer graphics-

1. Key-board
2. Mouse
3. Track ball and space ball
4. Joysticks

PAGE NO :
DATE : / /

5. Data glove 6. Digitizers
7. Image scanner

Data glove – A data glove is an input device that is essentially a glove worn on the hand that contains various electronic sensors that monitor the hand's movements and transform them into a form of input for applications such as virtual reality and robotics.

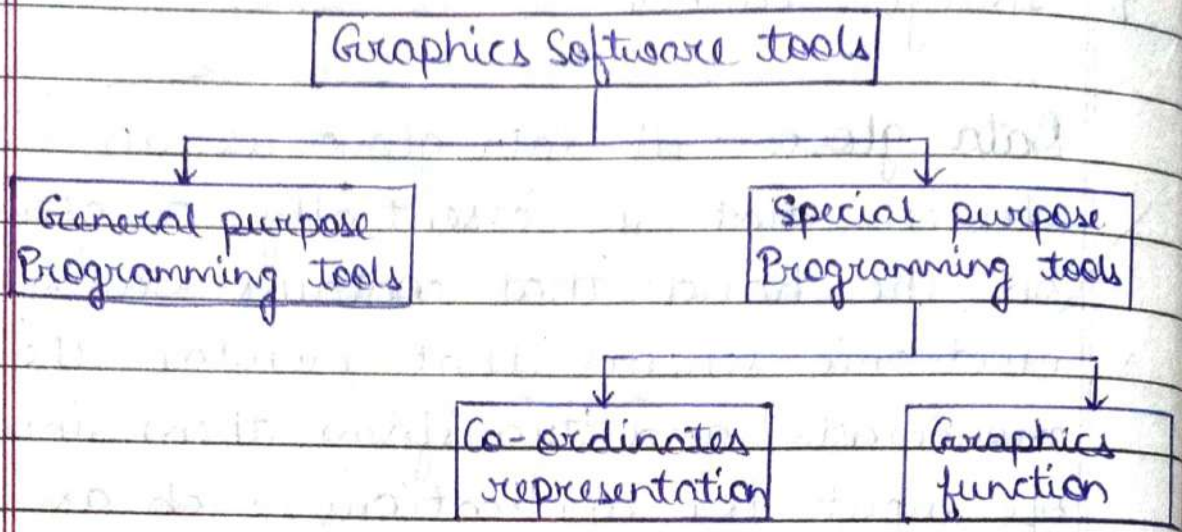
Digitizer – A digitizer (also known as a graphic tablet, drawing tablet, pen tablet or digital art board) is a computer input device that enables a user to hand-draw images, animations and graphics, with a special pen-like stylus, similar to the way a person draws images with a pencil and paper. These tablets may also be used to capture data or handwritten signatures.

★ **Graphics Tools :-**

In computer graphics, graphic tools is a mechanism to provide the functionality to create graphics objects. There are many types of software package, with the help of them we can create graphics software like – dreams viewer, series of Adobe photoshop.

PAGE NO :
DATE : 13 / Feb / 2019

Classification of computer graphics tools -



- **General purpose programming tools** – The general purpose programming package provide an extensive set of graphics function that can be used in high level programming language like – C and Fortran, C++.
An example of general purpose graphics programming package is GL (Graphics Library). Basic functions in general purpose programming package include those generating picture component. (straight line, circle, polygon and ellipse etc.)

- **Special purpose programming tools** – The application graphics package are designed for special purpose, so that user can generate display without

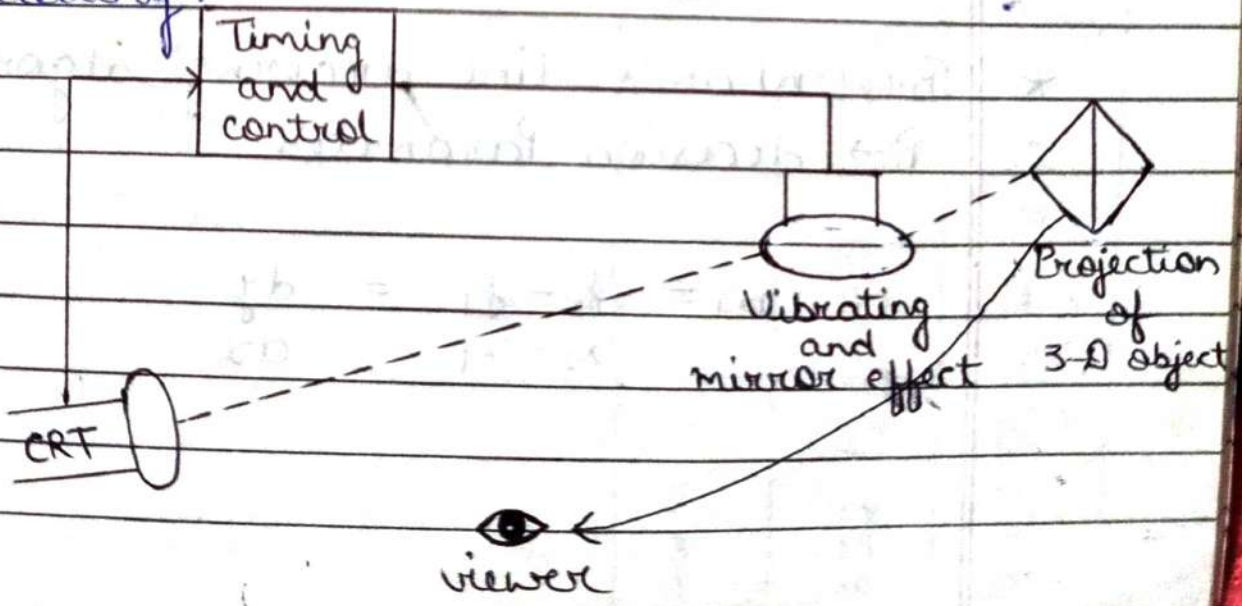
DATE: / /

working graphics operation work. The interface in graphics routines in such package allow the users to communicate with programs in their own terms.

* **3-D effect:-**

In computer graphics, for display of 3-dimensional screen (object) have been devised using techniques that reflect a CRT image from a vibrating, flexible mirror.

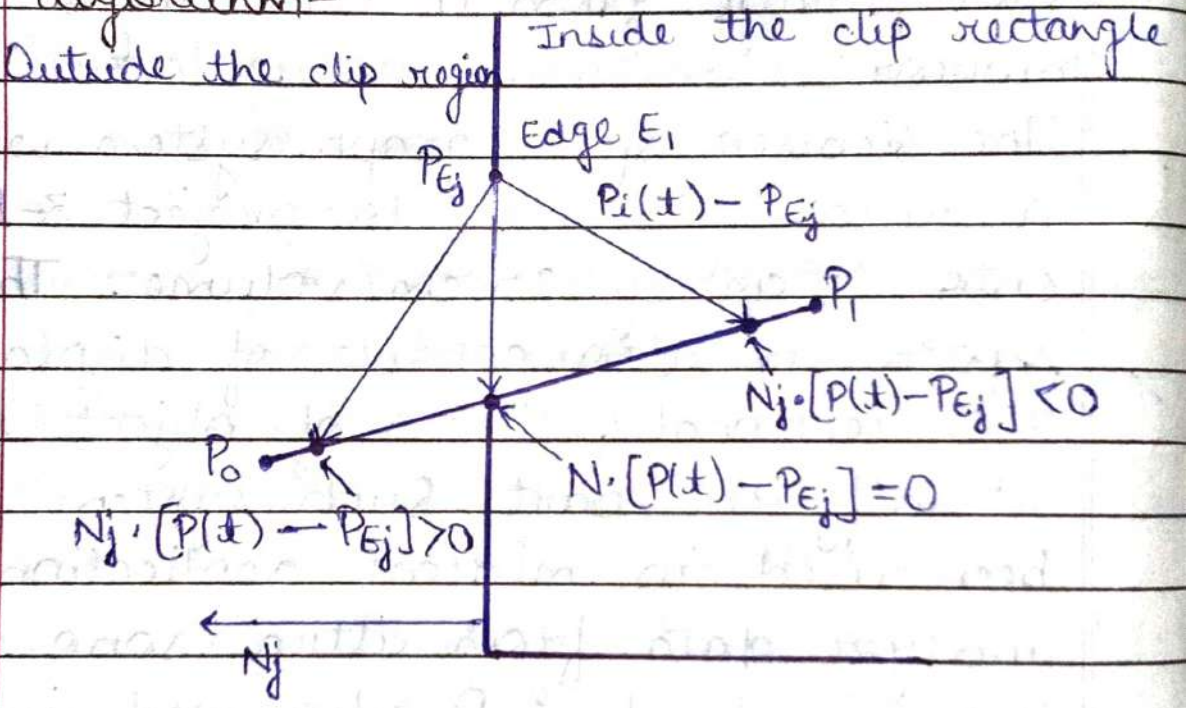
The Genisco space-graph system which use a vibrating mirror to project 3-D object onto 25 cm by 25 cm volume. This graph system is also capable of displaying 2-D sectional (slices) of object selected at different part. Such system have been used in medical application to analyze data from ultra-sono graphics. The effect of 3-D also used in simulation modelling.



PAGE NO :
DATE : / /

Another technique for representing 3-D object is displaying stereo scopic views. This method does not produce 3-D image but it provides a 3-D effect by presenting different views to user's eye.

* Diagram of Cyrus-Beck line clipping algorithm-



* Bresenham's line drawing algorithm-

P → decision Parameter

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{dy}{dx}$$

PAGE NO:
DATE: / /

$m < 1$		else	
$P<0$	else	$P<0$	
$x = x+1$	$x = x+1$	$x =$ NO change	$x = x+1$
$y =$ no change	$y = y+1$	$y = y+1$	$y = y+1$
$P = P+2dy$	$P = P+2dy-2dx$	$P = P+2dy$	$P = P+2dy-2dx$

Q- (1,1), (8,5)

slope $= \frac{4}{7} = 0.57$

P	x	y
1	1	1
-5	2	2
3	3	2
-3	4	3
5	5	3
-1	6	4
7	7	4
1	8	5

Q- (20,10) (30,18)

slope $= \frac{18-10}{30-20}$

$= \frac{8^{4}}{10 \times 5} = \frac{4}{5}$

$= 0.8$

P	x	y
1	20	10
-1	21	11
7	22	11
5	23	12
3	24	13
1	25	14
-1	26	15
7	27	15
5	28	16
3	29	17
1	30	18

UNIT-3

Geometric Transformation

* **Translation** — Translation is the process of moving an object from its original location to another new location with respect to its direction. If the displacement is given by the vector $V = t_x I + t_y J$, new object location with respect to the old vector is

$$V' = I' + J'$$

where t_x = translation in x-axis and
t_y = translation in y-axis

* **Transformation** :- Transformation is the process or method or mechanism by which we can change the shape, position and direction of any object with respect to any coordinate system by translation, rotation, scaling and reflection.

Basically transformation is categorised in two ways -

1. Geometric transformation
2. Coordinate transformation

1- **Geometric transformation** – Every object in computer graphics is assumed as a set of point or pixel. In 2- dimensional transformation each object point P has coordinate (x, y) and the object calculate the sum of all coordinates in geometric transformation. When any object is transfer to a new location then coordinate of new location can be obtain by the application of geometric transformation. There are 3 methods to calculate new location of an object -

(i) Translation (iv) Mirror reflection
(ii) Rotation
(iii) Scaling

2- **Coordinate transformation** – In this method we calculate the all coordinates location with respect to the object. At the starting coordinate we assume the next coordinate with respect to old coordinate and last coordinate of the transformation.

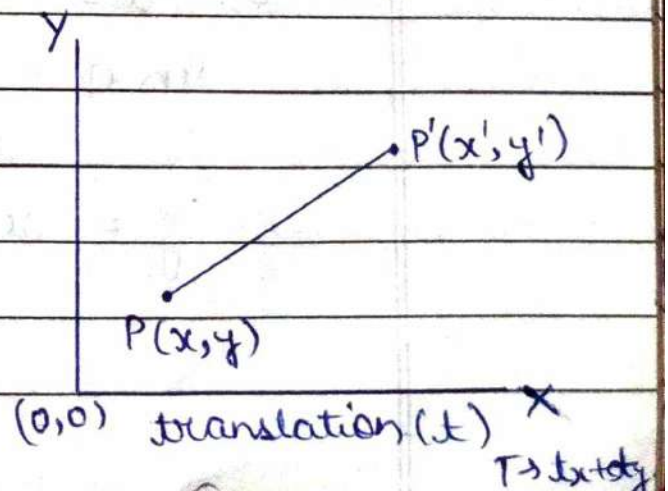
(i) **Translation** –

$x = t_x$

$y = t_y$

$x' = x + t_x$

$y' = y + t_y$

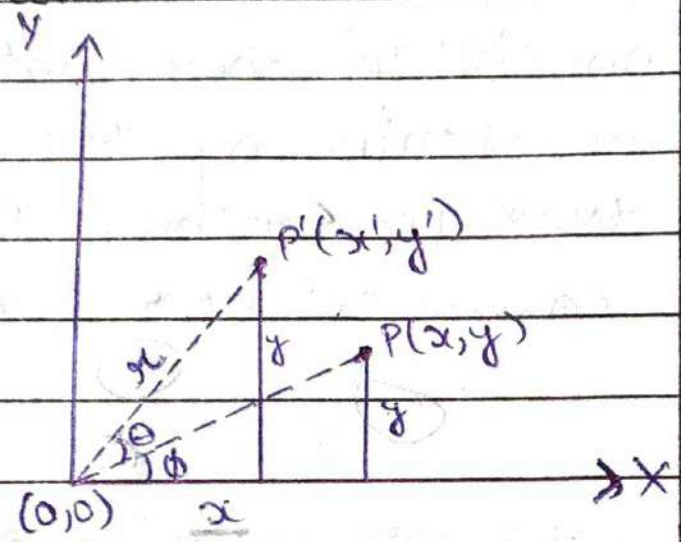


$$P' = T + P$$

$$P' = \begin{bmatrix} x' \\ y' \end{bmatrix}$$

$$T = \begin{bmatrix} tx \\ ty \end{bmatrix} \qquad P = \begin{bmatrix} x \\ y \end{bmatrix}$$

(ii) Rotation –



$$x' = r\cos(\phi+\theta)$$

$$y' = r\sin(\phi+\theta)$$

$$\cos\theta = \frac{x'}{r}$$

$$\sin\theta = \frac{y'}{r}$$

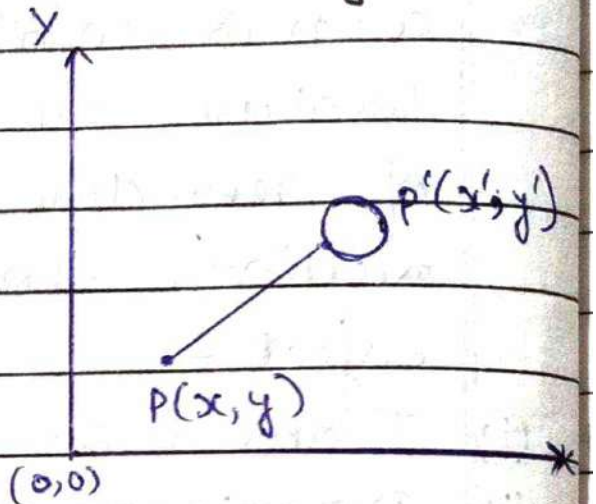
$$\cos\phi = \frac{x}{r}$$

$$\Rightarrow x = r\cos\phi$$

$$\sin\phi = \frac{y}{r}.$$

$$\Rightarrow y = r\sin\phi$$

(iii) Scaling –



$$x' = x \cdot Sx$$

$$y' = y \cdot Sy$$

Sx → Scaling factor with x-axis

Sy → Scaling factor with y-axis

$$P' = P \cdot S$$

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix} \begin{bmatrix} Sx \\ Sy \end{bmatrix}$$

$$x' = r(\cos\phi\cos\theta - \sin\phi\sin\theta)$$
$$x' = r\cos\phi\cos\theta - r\sin\phi\sin\theta$$
$$x' = x\cos\theta - y\sin\theta$$

$$y' = r(\sin\phi\cos\theta + \cos\phi\sin\theta)$$
$$y' = r\sin\phi\cos\theta + r\cos\phi\sin\theta$$
$$y' = y\cos\theta + x\sin\theta$$

$$\boxed{P' = R \cdot P}$$

$$P' = \begin{bmatrix} x' \\ y' \end{bmatrix}$$

$$R = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

$$P' = \begin{bmatrix} x \\ y \end{bmatrix} \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

* **Homogeneous scaling :-** When we are talking about homogeneous scaling there two scaling factors S_x scale factor for the x-coordinate and S_y scale factor for y-coordinate.

If $S_x = S_y$ then the scaling transformation is said to be homogeneous scaling. It means x-coordinate scaling factor are equal to y-coordinate scaling factor.

* **Magnification** — There are two scaling factors S_x and S_y for respect to coordinate x and y.
If $S_x = S_y > 1$ then scaling coordinate are called magnification scaling factor.

* **Reduction** — There are two scaling factors S_x and S_y for respect to coordinate x and y.
If $S_x = S_y < 1$ then the scaling coordinate are called reduction scaling factor.

Homogeneous Coordinate :-
Homogeneous coordinates are wide spread in computer graphics because they allow common vector operations such as translation, rotation, scaling and presectetive projection to be represented as a matrix by which the vector is multiplied.
In CG, we usually use homogeneous coordinate to represent 3D points.
Each coordinate has four dimensions - the normal three and a plus '1'.
Expressing positions in homogeneous coordinates allow us to represent all geometric transformation equations as matrix representation (multiplications).

* **Aspect ratio :-** Aspect ratio is the term of any object is visible in window port. There are two types of aspect ratio -

1- Window ~~view~~ port -

Window aspect ratio $a_w = \frac{Wx_{max} - Wx_{min}}{Wy_{max} - Wy_{min}}$

2- View port -

View port aspect ratio $a_v = \frac{Vx_{max} - Vx_{min}}{Vy_{max} - Vy_{min}}$

* **Viewing transformation :-**

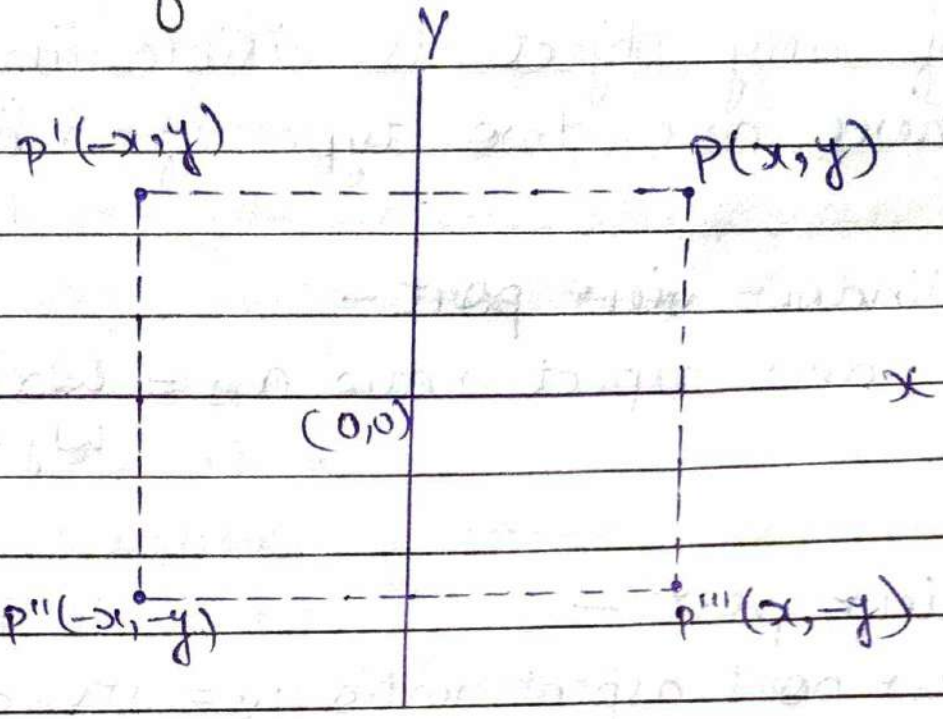
Suppose we want to convert the object into image and view port then we will do it for 3 steps to converting an object into view port.

The positioning is just moving the left lower corner of the window and the left lower corner of the view port.

First moving it to origin then scaling as required to view onto the screen space then again that its original position.

Translate (origin point)	→	Scaling	→	Translate (its original point)

* Mirror Reflection :-



If we assume any axis as a mirror then the object has denote a mirror image or reflection image.
The reflection of object P is obtain at the same direction from the axis as P.
And the coordinate of P' is given by following equation -

$$P' = M_x \times P$$

and $$P' = M_y P$$

where $x' = -x$

$y' = y$

Similarly as coordinate of P', we calculate next two coordinate P'' and P''' as the given value of x and y of P'.

* **Composite transformation :-** A composite transformation is two or more transformation performed one after other. Sometime a composition of transformation is equivalent to a similar transformation. We can set-up a matrix for any sequence of transformation as a composite transformation by calculating the matrix product of individual transformation.

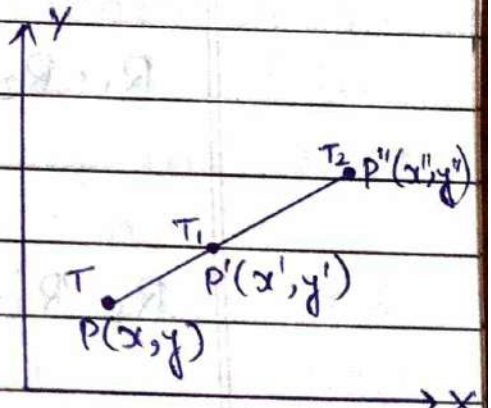
• **Composite transformation matrix representation-**

1. **Translation -**

$$P' = T + P$$

$$P' = T_{(t_x, t_y)} + P$$

$$\boxed{P'' = T_{(x+x_1, y+y_1)} + P}$$



$$P'' = T_{(x+x_1+x_2+\dots x_n,\ y+y_1+y_2+\dots y_n)} + P$$

$$P'' = [T_1 \cdot T_2] + P$$

$$P'' = [T_1(x_1, y_1) \cdot T_2(x_2, y_2)] + P$$

$$P'' = \begin{bmatrix} 1 & 0 & x_1 \\ 0 & 1 & y_1 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & x_2 \\ 0 & 1 & y_2 \\ 0 & 0 & 1 \end{bmatrix} + P$$

$$P'' = \begin{bmatrix} 1 & 0 & x_1 + x_2 \\ 0 & 1 & y_1 + y_2 \\ 0 & 0 & 1 \end{bmatrix} + P$$

2. Rotation –

$$P' = R \cdot P$$

$$\boxed{P' = R(\theta_1 + \theta_2) \cdot P}$$

or $$P' = R(\theta_1 + \theta_2 + \theta_3 + \dots + \theta_n) \cdot P$$

$$P' = (x', y')$$

$$P = (x, y)$$

$$R = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$P' = [R_1 \cdot R_2] \cdot P$$

$$R_1 \cdot R_2 = \begin{bmatrix} \cos\theta_1 & -\sin\theta_1 & 0 \\ \sin\theta_1 & \cos\theta_1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \cos\theta_2 & -\sin\theta_2 & 0 \\ \sin\theta_2 & \cos\theta_2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$R_1 \cdot R_2 = \begin{bmatrix} \cos\theta_1\cos\theta_2 - \sin\theta_1\sin\theta_2 & -\cos\theta_1\sin\theta_2 - \sin\theta_1\cos\theta_2 & 0 \\ \sin\theta_1\cos\theta_2 + \cos\theta_1\sin\theta_2 & -\sin\theta_1\sin\theta_2 + \cos\theta_1\cos\theta_2 & 0 \\ 0 & & 1 \end{bmatrix}$$

$$P' = \begin{bmatrix} \cos(\theta_1+\theta_2) & -\sin(\theta_1+\theta_2) & 0 \\ \sin(\theta_1+\theta_2) & \cos(\theta_1+\theta_2) & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot P$$

3. Scaling –

$$P' = S \cdot P$$

$$P' = (x', y') \quad , \quad P = (x, y)$$

$$S = (S_x, S_y)$$

$$S = \begin{bmatrix} S_x & 0 & 0 \\ 0 & S_y & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

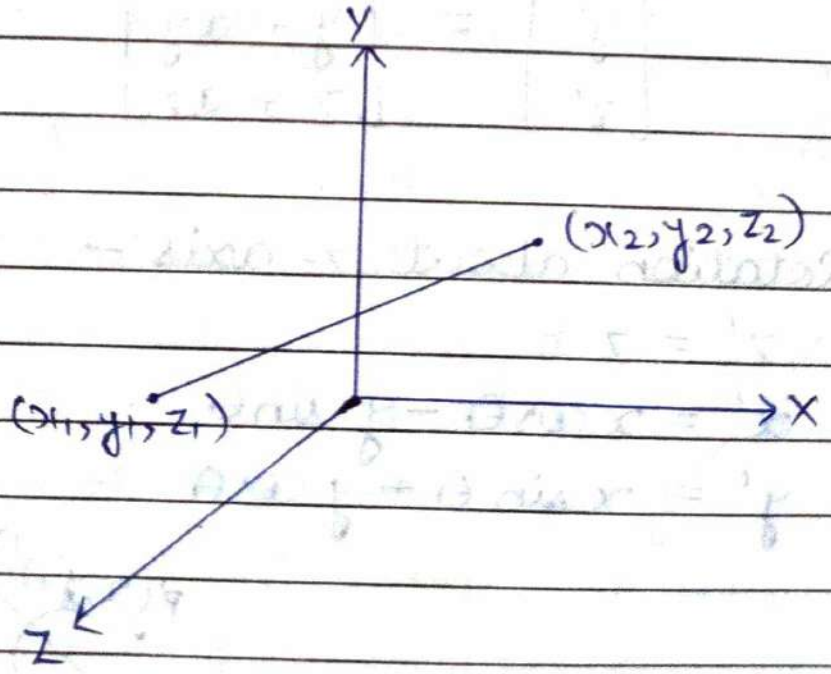
$$S_1 \cdot S_2 = \begin{bmatrix} Sx_1 & 0 & 0 \\ 0 & Sy_1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} Sx_2 & 0 & 0 \\ 0 & Sy_2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$S_1 \cdot S_2 = \begin{bmatrix} Sx_1 \cdot Sx_2 & 0 & 0 \\ 0 & Sy_1 \cdot Sy_2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$P' = S[Sx_1 \cdot Sx_2 + Sy_1 \cdot Sy_2] \cdot P$$

★ **3-Dimension :-**

The method of 3-dimensional (3-D) representation of an object containing 3-coordinates (x, y, z) or a point but in 2-dimensional representation of an object have two coordinates (x, y). Now we translate an object by specifying a 3-D transaction vector which determine how much the object is to be moved in each of 3-coordinate direction.



- 3-D Transformation –

1- Translation

2- Rotation → Rotation about z-axis
→ Rotation about x-axis
→ Rotation about y-axis

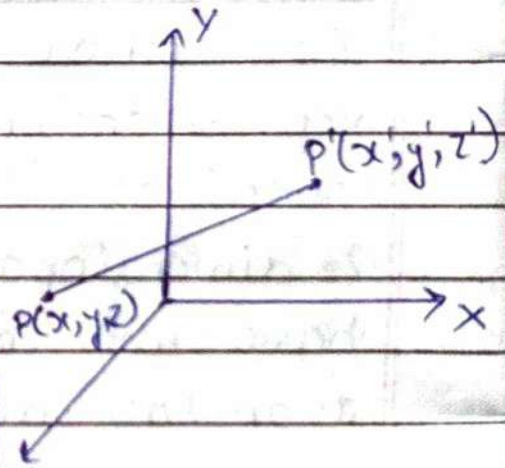
3- Scaling

Angle ⇒ Clockwise ($-\theta$)
Anticlockwise (θ)

1. Translation –

$$x' = x + tx$$
$$y' = y + ty$$
$$z' = z + tz$$

$$P' = P + T$$

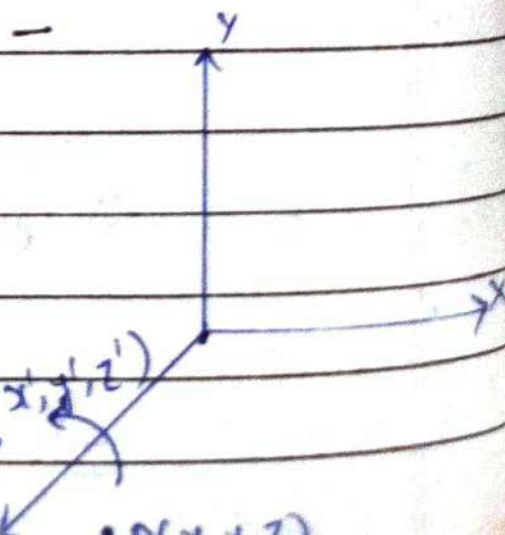


$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} x \\ y \\ z \end{bmatrix} + \begin{bmatrix} tx \\ ty \\ tz \end{bmatrix}$$

$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} x + tx \\ y + ty \\ z + tz \end{bmatrix}$$

2.(i) Rotation about z-axis –

$$z' = z$$
$$x' = x\cos\theta - y\sin\theta$$
$$y' = x\sin\theta + y\cos\theta$$

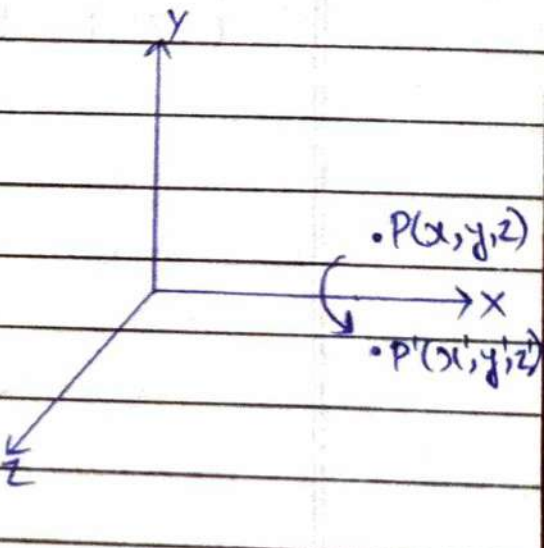


$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

$$= \begin{bmatrix} x\cos\theta - y\sin\theta \\ x\sin\theta + y\cos\theta \\ z \end{bmatrix}$$

(ii) Rotation about x-axis –

$$x' = x$$
$$y' = y\cos\theta - z\sin\theta$$
$$z' = y\sin\theta + z\cos\theta$$

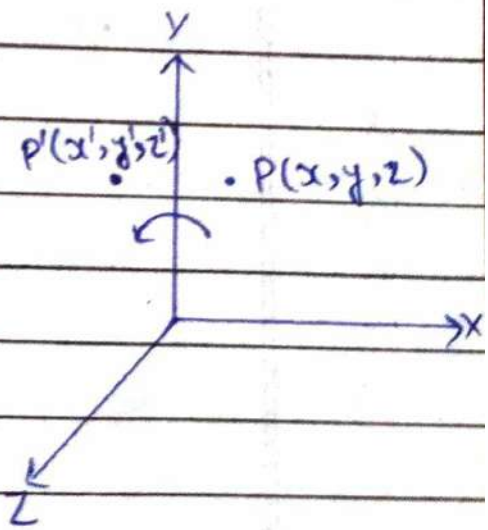


$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

$$= \begin{bmatrix} x \\ y\cos\theta - z\sin\theta \\ y\sin\theta + z\cos\theta \end{bmatrix}$$

(iii) Rotation about y-axis –

$$y' = y$$
$$x' = x\cos\theta - z\sin\theta$$
$$z' = x\sin\theta + z\cos\theta$$



$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} \cos\theta & 0 & -\sin\theta \\ 0 & 1 & 0 \\ \sin\theta & 0 & \cos\theta \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

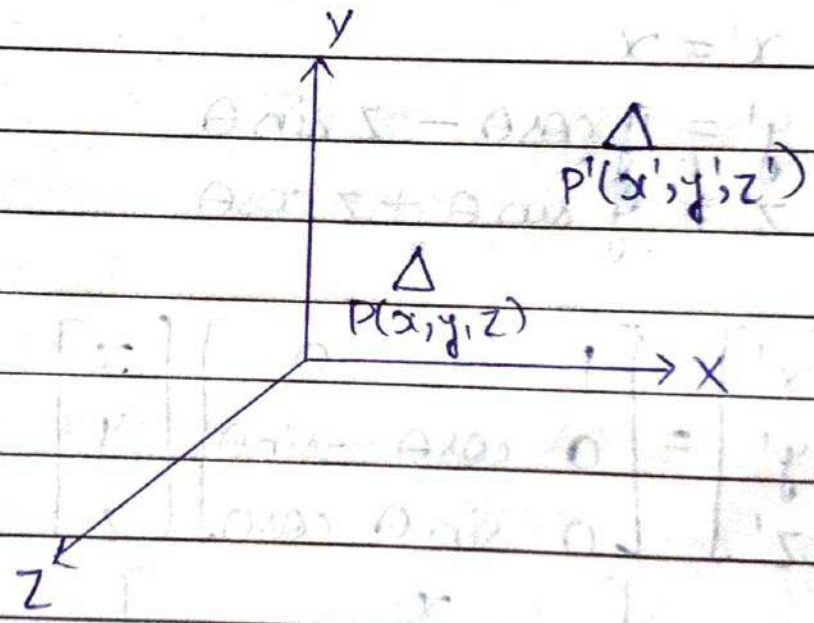
$$= \begin{bmatrix} x\cos\theta - z\sin\theta \\ y \\ x\sin\theta + z\cos\theta \end{bmatrix}$$

3- Scaling –

$$P' = S \cdot P$$

$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} Sx & 0 & 0 \\ 0 & Sy & 0 \\ 0 & 0 & Sz \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} x \cdot Sx \\ y \cdot Sy \\ z \cdot Sz \end{bmatrix}$$



UNIT - 4

Representing Curve and Polygon Surfaces

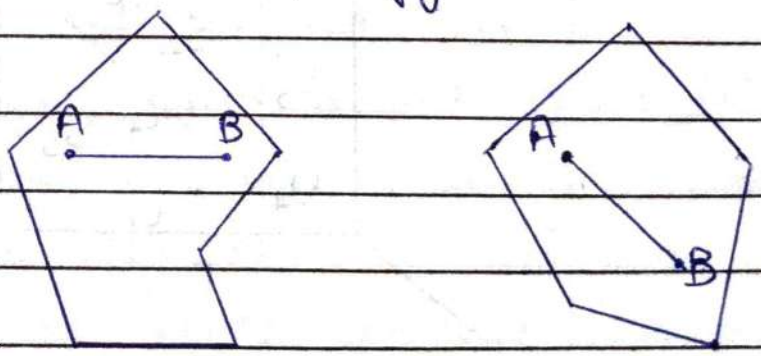
* **Polygon :-** A polygon is any 2-dimensional shape formed with straight line. Triangle, rectangle, pentagon, hexagon etc are the examples of polygon.

Polygon is a closed shape with straight sides. The word polygon came from the Greek like most term in geometry. Simple means of polygon poly → many and gon → angle.

There are 2 types of polygon in computer graphics –

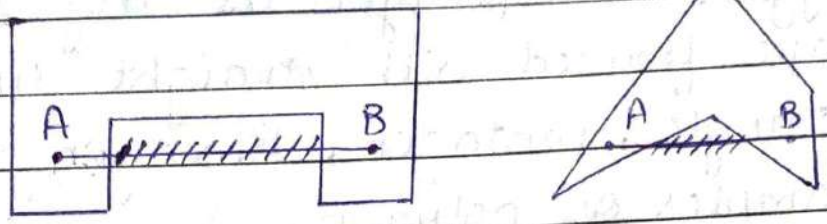
(i) Convex
(ii) Concave

1- **Convex –** If the line connecting two interior points of the polygon lies completely inside the polygon, it is said to be convex. The respected points are inside the polygon.

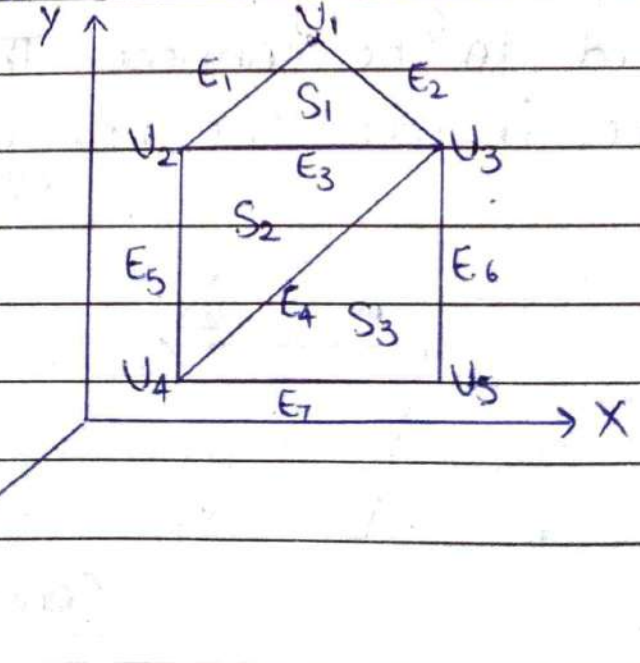


Convex

2. Concave – Line joining any two interior points of the polygon is not completely inside the polygon that are called concave.



* Polygon table :- The polygon table contain the all surface (vertex, edge and surface) information about the polygon with set of coordinate and associated parameter. Geometric table contain vertex coordinate and parameter to specify the orientation of the polygon surface. Attribute information for an object include parameter specify the degree of transparency of the object and its surface reflect and texture characteristics.



Vertex table
$V_1 = (x_1, y_1, z_1)$
$V_2 = (x_2, y_2, z_2)$
$V_3 = (x_3, y_3, z_3)$
$V_4 = (x_4, y_4, z_4)$
$V_5 = (x_5, y_5, z_5)$

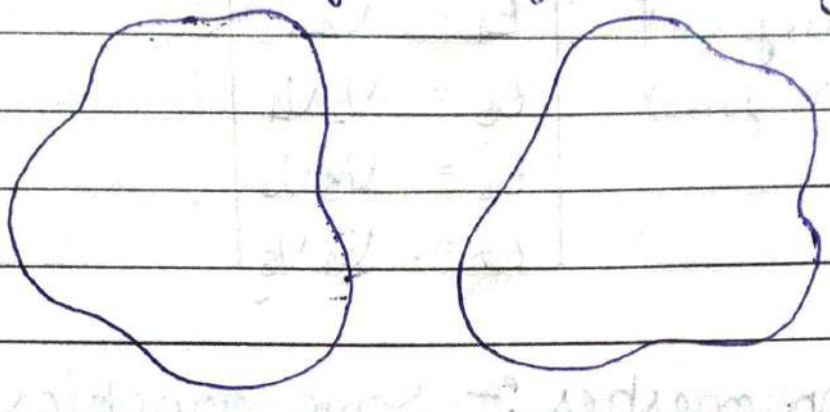
Edge table
$E_1 = V_1V_2$
$E_2 = V_1V_3$
$E_3 = V_2V_3$
$E_4 = V_4V_3$
$E_5 = V_2V_4$
$E_6 = V_3V_5$
$E_7 = V_4V_5$

Surface table
$S_1 = E_1E_2E_3$
$S_2 = E_3E_5E_4$
$S_3 = E_4E_6E_7$

* **Polygon meshes :-** Some graphics package provide several polygon function for modelling object. A single plane surface can be specify with functions such as fill area but when object surface are to tiled. It is more easy to specify the surface facts with a mesh function. A type of polygon mesh is the minimum triangle tree. When polygon mesh specify with more than 3 vertices it is possible that vertices may not lies on the plane.

* **Blobby object or curve in CG :-** Some object do not maintain a fixed shape but change their surface characteristics in certain position or when in approximity to other objects.
Example of these objects include molecular

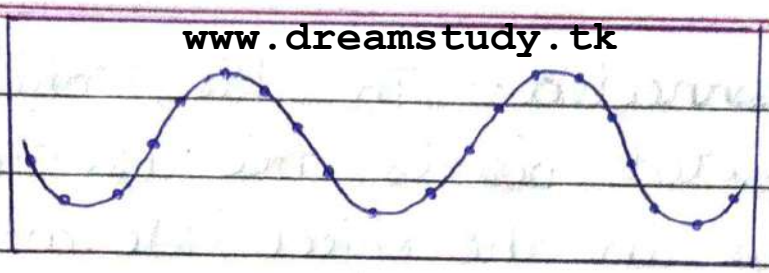
structure, water drops and other liquid effects. These objects can be described as a blobby object. Their shape show a certain degree of fluidity.



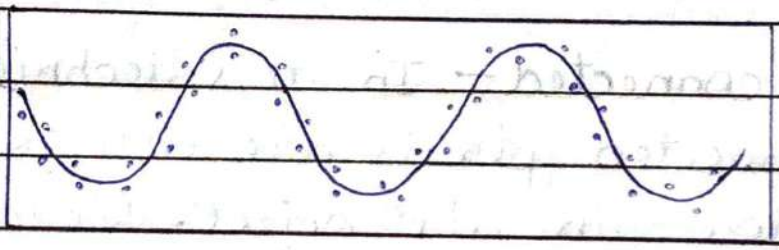
- **Curve representation** :- Curve representation is a method to identify the curved object is to be belong their respected pixels. There are basically two types of curve representation (SP line - Straight Point line).

1. Intropolation
2. Approximation

1- **Intropolation** – We specify a SP line curve by giving a set of coordinate position called control point which indicate the general shape of the curve. These control points are fitted piecewise. When polynomial section are fit on the control point, the result of curve is said to be intropolation.



2- **Approximation** – When a SP line curve are fitted to general control point path without passing through any control point (nearby of control point) the result curve is said to be approximation. Approximation SP line curve do not pass (touch) the control-point.



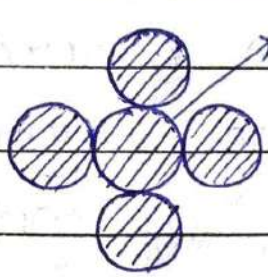
* **Boundary fill algorithm**:- Boundary fill algorithm works as its name. This algorithm pick a point inside the object and start to fill until it touch the boundary of the object. The colour of the boundary, we assume same as well as object and boundary.

There are 2 methods of boundary fill algorithm use to fill the colour in the object -

4- connected

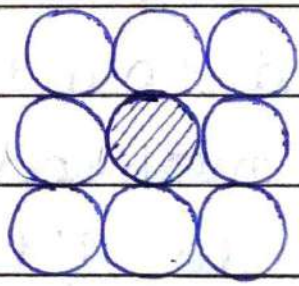
8- connected

1. 4-connected – In this technique four connected pixels are use to fill the colour in the object. We are putting the pixel of entire pixel to above, behind, top and bottom.



And this process will continue until we find the boundary of object.

2. 8-connected – In this technique, eight-connected pixels are use to fill the colour in the object. We are putting pixel above, below, right and left side of the current entire pixel as we use in 4-connected technique. In addition to this we are also putting pixel in diagonals so then entire area of the current pixel is completely covered.



Algorithm –

Step 1 – Choose a random entire point which is consider object.

Step 2 – Each pixel to the left, right, top and bottom are tested (covered).

Step 3 – Repeat process until all pixels upto the boundary colour all the area have been tested (covered).

★ **Absolute Polygon Algorithm :-** In absolute polygon algorithm, these steps include –

Step 1 – Input the array containing the vertices of the polygon.

Step 2 – Identify the all number of sides of polygon.

Step 3 – Coordinate of current point position and a vertical stepping of the polygon side.

Step 4 – Check the number of vertices of all side that is greater than 3 or equal to 3.

Step 5 – Finally enter the instruction for the sides (vertices and edges) and return.

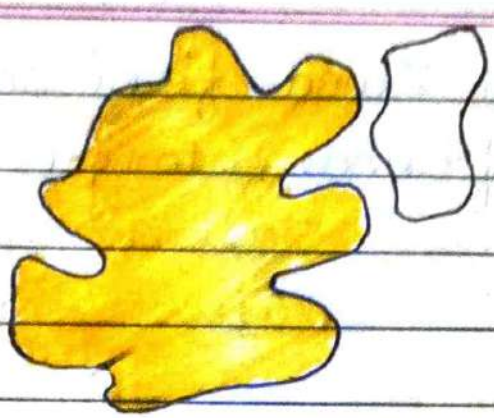
Flood Fill Algorithm

Introduction :- Flood fill, also called seed fill, is an algorithm that determines the area connected to a given node in a multi-dimensional array. It is used in the "bucket" fill tool of paint programs to fill connected, similarly-colored areas with a different color.

Concept :-

- Flood fill colors an entire area in an enclose figure through interconnected pixels using a single color.
- It is an easy way to fill color in the graphics. One just take the shape and starts flood fill.
- The algorithm works in a manner so as to give all the pixels inside the boundary the same color, leaving the boundary and pixels outside.
- By this algorithm, we can recolor an area that is not defined within a single color boundary.

DATE : / /



Flood fill

Algorithm :- The flood fill algorithm takes three parameters : a start node, a target color and a replacement color. The algorithm looks for all nodes in the array that are connected to the start node by a path of the target color and changes them to the replacement color.

Flood-fill (node, target-color, replacement-color)

1- If target-color is equal to replacement-color, return.

2- If the color of node is not equal to target-color, return.

3- Set the color of node to replacement-color.

4- Perform Flood-fill (one step to the south of node, target color, replacement-color.
Perform Flood-fill (one step to the north of node, target-color, replacement-color.
Perform Flood-fill (one step to the west

Perform Flood-fill (one step to the east of node, target-color, replacement-color).

5- Return.

Methods :- There are many ways in which the flood-fill algorithm can be structed, but they all make use of a queue or stack data structure, explicitly or implicitly.

Depending on whether we consider nodes touching at the corners connected or not, we have two variations — eight way and four-way respectively.

4-way recursive method — You call the function within its parameters : the start position, the oldcolor and the newcolor. Each seed gives the pixel at its position the new color, and then plants a new seed at its 4 neighbors.

8-way recursive method — This method is similar to the previous one, except it doesn't test 4 neighbors, but 8.

★ **Curve :-** A curve is an infinitely large set of points, Each point has two neighbour except end points, Curve can be broadly define in 3 categories -

1. Implicit
2. Explicit
3. Parametric

1- Implicit curve - Implicit curve represent define a set of points on a curve by employing a procedure that can test to see if a point is on the curve. Usually implicit curve is define by the function

$$\boxed{f(x,y) = 0}$$

It can represent multi-value curve (multiple value of x and y). Implicit curve representation is -

$$x^2 + y^2 - R^2 = 0$$

or $$\boxed{x^2 + y^2 = R^2}$$

2. Explicit curve - A mathematical function $y = f(x)$ can be plotted explicit curve. The explicit representation is not general function, since it cannot represent vertical lines and is also single value with the respect of x and y.

3- Parametric curve — Curve have parametric form are called parametric curve. The explicit and implicit curve representation can be used only when the function is given, but in parametric curve we calculate the functions with the help of parameter translation (t).

$$P(t) = f(t), g(t)$$

* **Bezier Curve** :- Bezier curve is discovered by French engineer Pierre Bezier. These curve can be generated under the control of other points. Approximation - curve is using as a control point in this method.

$$\sum_{K=0}^{n} P_i B_i^n(t)$$

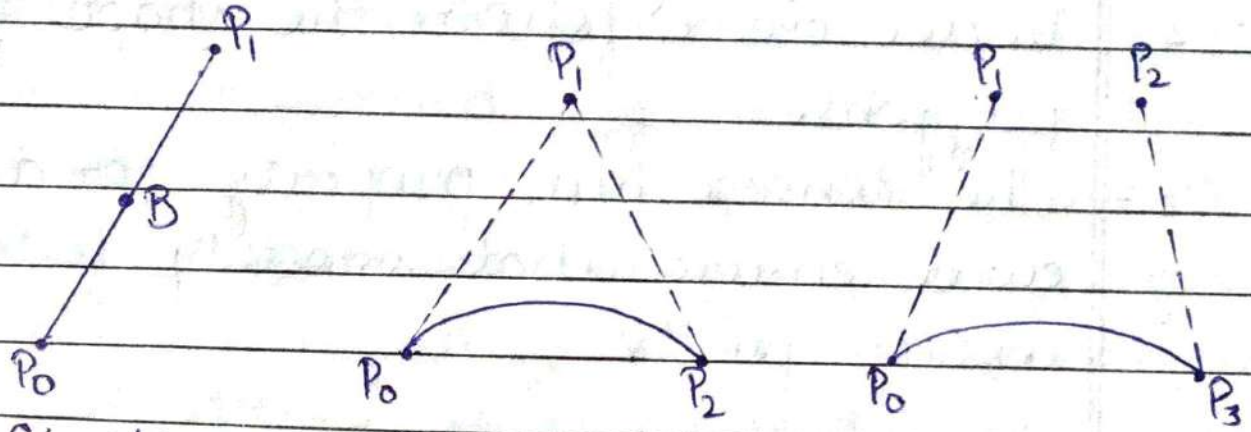
where P_i = set of points

n = number of polygon degree

t = variable

B_i^n = Berstein Polygon

- Types of Berier Curve :-



Simple Berier Curve | Quardratic Berier Curve | Cubic Berier Curve

Simple Berier curve is ~~donet~~ denoted by a straight line with two control points P_0 and P_1.

Quardratic Berier curve contain 3 control points P_0, P_1 and P_2. In quardratic Berier curve we apply approximation method to calculate their coordinates.

Cubic Berier curve contain 4 control points P_0, P_1, P_2 and P_3. Cubic Berier curve also apply approximation method to calculate the coordinates of a cube.

- Properties of Berier Curve —

1- Berier curve generally follow the shape of control polygons, which consist of segments joining with the control points.

2- They always pass through the first and last control points.

3- They are contain in the convex hull of

their defining control points.

4- Bezier curve follow the shape of defining polygons.

5- The convex hull property for a bezier curve ensure that smoothly follow all control points.

★ **Quadric Surface :-**

A frequently used class of objects are the quadric surface which are described with second degree equation (quardratic). They include spheres, ellipsoids, torus, paraboloids and hyperboloids. Quadric surface particularly spheres and ellipsoide are common element of graphic scene.

A quadric surface is the graph of second degree equation in the respect of 3 variables x, y and z. The most general equation used in quadric surface is -

$$Ax^2 + By^2 + Cz^2 + Dxy + Eyz + Fzx + Gx + Hy + Iz + K$$

★ **Solid modeling :-**

Solid modeling is the representation of solid part of an object which is visible on your computer screen. Providing surface representation with 3- dimension (3D) view

of geometric model make the object solid on computer screen.

Solid modeling is the most advanced method of geometric modeling in 3-dimension. Graphic scenes can contain many different kind of objects like - tree, flower, cloud, rocks - water, bricks, paper books etc.

- Advantages of solid modeling -
Solid modeling concept use to draw solid objects in computer graphics. Some softwares like CAD use it. The solid modeling CAD software help the designer to see the designed object as if it were the real world manufacturing product. It can be seen from various directions and various views.
This help the designer to be sure that the object look like as well as it want to be draw.

- Process of making the solid-model - To make the solid model object you have to first make the wire frame model of the object and convert it into 3-D view. Thereafter the surface are added to the 3-D wire model convert it into 3-D

solid model.

- Applications of solid modeling – Solid modeling is not only used in creating solid objects but it also used in creating demo of buildings, electric circuits and even of the human beings. Solid modeling is also used in engineering, entertainment industry and medical sector.

- Boundary Representation (B-Rep) – Boundary representation a 3-dimensional object as a set of surface that seperate the object's interior point from the exterior point environment. It is a method for representing shapes using the limits of boundary control points. A B-Rep is represent as a collection of connected surface element.

- Space partitioning Representation – Space partition representation are use to describe interior points properties by partition of region containing an object into a set to small, none overlapping, contigous solid. A common space partition description for a 3-D

object is an octree representation. Hierarichal tree structure is called octree are used to represent solid object in some graphic system. Medical imagine and other applications that require display of object cross section commonly use octree representation. The octree structure is organise so that each node (control points) correspond to a region of 3-dimensional space.

- Sweep Representation –

Sweep Representations are useful for constructing three-dimensional objects that passes translational, rotational, or other symmetries. We can represent such objects by specifying a two-dimensional shape and a sweep that moves the space through a region of space.

Example– A prism can be generated using a translation sweep and rotational sweeps can be used to create curved surfaces like an ellipsoid or a torus.

More complex objects can be formed by using more complex transformations.

UNIT - 5
Multimedia

★ Multimedia :-

Multimedia is the medium that use multiple forms of information content and information processing (eg. text, audio, graphics, animation, video and inter activity.) to inform and entertainment to the user.

Multimedia also refer to the use of electronics media to store and experience multimedia content.

Mutimedia is used for communication.

Today multimedia ~~resides~~ resides in internet also. Our browser supports hyperlinks, playing external videos etc.

Multimedia is the field concerned with computer control integration of text, graphics, drawings, video, animation, audio and any other media where every type of information can

be represented, stored, transmitted and proceed digilitty.

* Characteristics of Multimedia system:
Multimedia have basically 4 characteristics –

1- Multimedia system must be computer controlled.
2- Multimedia system are integrated.
3- The information representated by digitalize.
4- The interface of the final presentation of media must be interactive.

* Multimedia Technology :- (Terminology)

1. Media
2. Temporal
3. Non - temporal media
4. Multimedia presentation
5. Multimedia content
6. Multimedia Network service
7. Multimedia software
8. Multimedia devices
9. Multimedia applications

2- Temporal media — The behaviour of temporal media during transformation is a function of time.

* Multimedia Architecture :- We need to organise clients, servers and storage servers that communicate through a network, multimedia system are put under 2 categories —

1- Single - user system
2- Multi - user system

1- Single - user system — Three types of multimedia system are used CD-ROM or hard disk to hold multimedia objects and scripting meta-data to orchestrate the play-out. The means of orchestrate is synchronisation and scheduling.

2- Multi - user system — Distributed multimedia system communicate through a network. They use many shared resources so resource management is quite complex. Some example of this system are —

(i) Video Over LAM
(ii) Internet through cable

DATE : 3 / Apr / 2019

(iii) Video conferencing

★ CD-ROM :-

A compact disk is an optical disk used to store digital data developed for storing digital audio. The CD available in the market since 1982, remains the standard playback medium for commercial audio recording to the present. An audio CD consist one or more stereo track using 16 bit coding at the sample rate 44.1 KHz. Standard CD have a diameter of 120 mm and can hold approximately 80 minute audio.

★ Physical details of CD-ROM — A compact disk is made from a 1.2 mm thick disk of almost pure polycarbonate plastic and weight approx 16 gm. A thin layer of aluminium (or rarely gold use for its long-life) is applied to the surface of it for making reflective and protected. CD data is stored as a series of tiny indection (pits) encoded in a tightly packed spiral track model into the top of the polycarbonate layer. Each pits is approximately 100 nm (nano-meter) deep

by 500 nm wide and varies from 850 nm to 3.5 μm in length.

* **CD-ROM and Multimedia Highway :-**

As we know multimedia require large amount of digital memory when stored in an end's user's library or big amount of bandwidth when distributed over wires, glass fibre or air waves on a network. For transfer of large content we need large bandwidth so that the content can be deliever to end user speedly. This can be possible by various storage medium like CD-ROM and DVD etc.

In the very long term CD-ROM and DVD disc are used for store multimedia information as the data highway describe the track of flow the multimedia information. Today's tele-communication networks are global and when information provider and content owner determine the worth of their product and how to charge money of these information.

Multimedia information elements will ultimately link-up online as distributed resources on a data highway where you will pay to acquire and use

multimedia based information.

All companies will own the routes for carrying data other companies will own hardware and software interface at the end of the line like- office and home. They will provide supply on demand and billing services.

* Disc v/s disk :-

Disc — A disc refers to optical media such as an audio CD, CD-ROM, DVD-ROM or DVD-video disc. All discs are removable, means when you unmount the disc, it physically comes out of your computer.

Some discs are read-only (ROM) and some can be erased and rewritten over many times.

Disk — A disk refers to magnetic media such as a floppy disk, the disk on your computer's hardware, an external harddrive. Disks are always rewrita-ble. Disks are usually sealed inside a metal or plastic casing.

Assignment

Authoring System In Multimedia :-

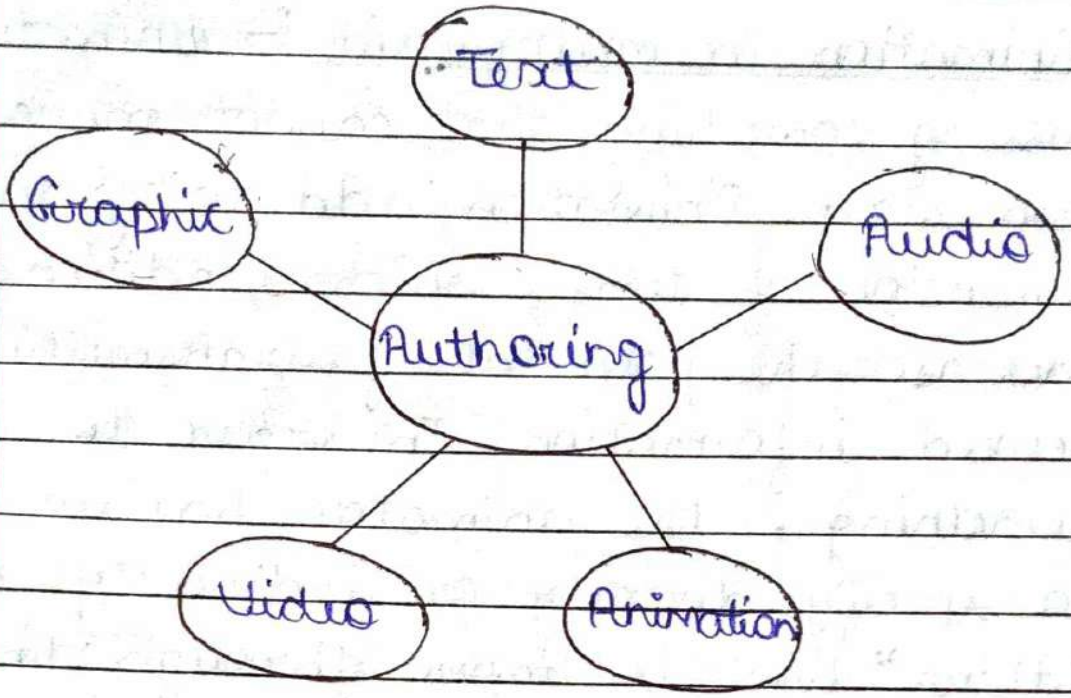
Authoring systems can be defined as software that allows its user to create multimedia applications manipulating multimedia objects. Generally authoring system provide lots of graphics, interaction and other tools educational software need.

How is multimedia authoring software used ?

Multimedia authoring software allows teachers and students to integrate many forms of multimedia. For example, audio, animation, text, hypertext, video, graphics and images into software program.

These multimedia authoring software tools are used to create business presentations, games, CDs and DVDs.

DATE: / /



Types of Multimedia Authoring System:-

1- Dedicated authoring system
e.g. - Microsoft Power Point

2- Timeline based authoring system
eg. - Adobe Flash

3- Programmable authoring system
eg. - Javascript

* **Animation in multimedia** :- Animation is moving something that cannot move on its own state. Animation add to graphics the dimension of time, which traditionally increase the potential of transmitting the desired information. In order to animate something, the animator has to be able to specify directly or indirectly how the "thing" has to move through time and space.

* Traditional method of animation –
Traditionally, most of animation work on the method of frame concept. Animation requires 24 frames in each animation. content which work required to create even the shortest of movies can be combination of images. Some of the traditionally used methods are described below –

1. Keyframes
2. Cell animation
3. Rotascoping
4. Computer animation
5. Keyframing
6. Simulation
7. Motion capture

- Motion Capture – Motion capture is the process of recording the movement of object or people. It is used in military, entertainment, sports and medical sector for validation of computer vision and robotics.

- Keyframe – In media production, a keyframe is a location on a timeline which marks the beginning or end of a transition. It holds special information that defines where a transition should start or stop. The intermediate frames are interpolated over time between those definitions to create the illusion of motion. In computer animation, like 3-D animation or non-linear video editing, this interpolation is performed mathematically by the CPU.

- Simulation – Simulation is the process of creating an abstract representation (a model) to represent important aspects of real world. Just as flight simulators have long been used to help expose pilots and designers to both routine and unexpected circumstances, simulation models can help you explore the behaviour of your

system under specified situations.

* 2-D Animation :- 2-D animation creates movement in a two-dimensional artistic space. In 2D animation, a character is drawn by hand, on computer, or a combination of both. Even with today's technology, most traditional 2D animation starts with drawings. The artist creates a whole series of images, one after another, making slight changes in the character's position. When these images are run together quickly, it creates the effect of movement.

3-D Animation :- 3-D animation comprises of objects in height, width and depth. In other words, characters are going to be more realistic contrast to 2D characters. 3D animation is the form of animation that is completely done with a computer. The 3D animation allow you to do things that are not possible in 2D animation.

* Difference between 2D and 3D animation:-

	2-D animation	3-D animation
1-	2D animation implies that the object is two dimensional.	3-D animation implies that the object is three dimensional.
2-	2D animation comprises of characters or objects only in height and width.	3-D animation comprises of objects in height, width and depth.
3-	2D animation objects are created by traditional drawing method. Each move of the character has to be created frame by frame.	In 3D animation, everything is going to be done in available computer software. The development consist of several phases steps such as modelling, texturing, lighting, rendering etc.
4-	2D animation is all about frames.	3D animation is all about movement.
5-	It is not suitable for conceptual drawing as you can only represent in two-dimensions.	3D animation is impeccable for conceptual designing as it results is all the 3 dimensions.
6-	2D animation is widely implemented in films, advertisements, cartoon shows, websites, e-learning.	3D animation is widely used in gaming, movies, biotechnology, medical.

UNIT – 6

* Production planning in multimedia :-
These are the steps that are used in production planning of multimedia -

1- Defining the production schedule.
2- Devising a technical plan.
3- Project budgeting
(a) Cost of personnel (including part timer)
(b) Advertisement budget
(c) Video production
(d) Audio production
(e) Equipment
(f) Equipment renter
(g) Software
(h) Graphics and audio materials
(i) Royalties
(j) Material and supplier
(k) Printing
(l) Communication expense
(m) Office supplier
(n) Legal expense
(o) Travel
4- Planning and structure
(a) Defining the goal and objective of the proposed multimedia title
b) Describing the content of the title.

(c) Developing the application script.
(d) Translating the application script into an outline.
(e) Translating outline into flowchart.
(f) Develop the screenshot.

5- Goal and objective define.
(a) What are the purpose of proposed title.
(b) What is the team trying to accomplish.
(c) What are the expected result.

6- Program content –
Text, video, sound, graphics, background content, photograph, 3-D graphics, chart, flowchart etc.

7- Multimedia application script

8- Outlining

9- Logical flowchart

10- Program storyboard

11- Production script for text, audio and video.

12- Hardware issue

13- Authoring system selection.

* Members of multimedia production team :-

1. Production manager
2. Content specialist
3. Script writer
4. Text editor

5. Multimedia architect
6. Computer graphics artist
7. Audio and video specialist
8. Computer programmer

* Testing and delievering process in multimedia application :-

1- Evaluation process — Testing of multimedia title is easy so that the final application quality standard need to high and it is not effected by bugs, technical snags, inaccurate information or single grammatical errors.

The process of evaluating (testing) and revising a multimedia application project is dynamic and constant. There are two types of evaluation :

(i) Internal evaluation
(ii) External evaluation

(i) Internal evaluation —

1. Application design
2. Project goal and objective
3. Multimedia content
4. Text and grammatical narration
5. Application graphics
6. Sound

7. Application navigation
8. Programming code
9. Delivery
10. Time and budget
11. Legal documentation

(ii) External evaluation — There are basically three testing used in external evaluation of multimedia application -

1. Alpha testing
2. Beta- testing
3. Focus group testing

- Alpha testing — Alpha testing is defined as a type of software testing performed to identify bugs before releasing the product to real users or the public. It is a type of acceptance testing. Alpha testing is done early on, near the end of the development of the software, and before Beta testing.

The main objective of alpha testing is to refine the software product by finding the bugs before the software is released and that were not discovered through previous tests.

- Beta testing — In software development, a beta test is the second phase of software testing in which a sampling of the intended audience tries the product out.
Beta testing is giving a finished or nearly finished product to a sample of current or potential users to evaluate its performance in the real world.

- Focus group testing — A focus group is crutial in software development projects, especially those in early stages. A focus group is a small group of individuals taked to review the software in a critical manner.

2. Quality Assurance — QA is the formal name given to the process of Beta-testing. When the Beta testing of a multimedia application is release and the functional testing start, the quality assurance process help formaly start. Quality assurance majorly focus on-

(i) Compatibility
(ii) Functionality
(iii) Functional localisation
(iv) Installation
(v) Performance
(vi) Stress

* Hardware and software requirement for good multimedia project :-

1- Hardware Consideration — Hardware consideration can be complex and even frustrating as new technologies are includes. The confusion, however can be minimize by concentrating on the media component needed to support the applications. As time goes on, the technology will provide greater quality at less cost and you will be ready to take advantage of new hardwares.

2- Technology trends —

(i) Comparision technology for graphics and
(ii) video images.
(iii) Sound cards.
(iv) Windows sound system
(v) Digital video card
(vi) CD-ROM
(vii) Computer platform and upgrades.

3- Multimedia PC standard (MPC) — One very popular standard has been developed to ensure that the computer system has all the necessary capabilities to run a multimedia software is called MPC. It

is introduced by Tsay in 1992.

4- Hardware requirements -

(i) Camera
(ii) Video monitor
(iii) Video capture board
(iv) Printer
(v) Scanner
(vi) Headphone
(vii) Microphone
(viii) Computer system unit (Mouse, keyboard, monitor etc.)

5- Software consideration - Hardware cannot done any job. Capable software is needed if you plan to build your own multimedia program. To accomplish these multiple roles requires multiple software components.

(i) Operating system
(ii) Authoring system
(iii) Graphics package
(iv) General purpose language
(v) Presentation and run time system

* Content Acquisition :-

Content - Content is the "stuff" around which an application is developed. It may be a text, narration, graphics,

colour, background, video and animation. In other words, content are all the elements that compose a multimedia average.

Content acquisition, identification, selection and development help in it. The main responsibility of content development like with the content specialist, script writer or computer graphics artist. A content specialist undertakes the following task -

1. Identify document sources.
2. Identification of the building blocks like colour, graphics representation theme, time to represent multimedia.
3. Identify individual views.
4. Location to be video taped.

Responsibility of script writer -

1- Content evaluation
2- Identify goal and objective
3- Script and story board based on content.

Responsibility of computer graphics artist —

1. Developing the necessary lines of the application.
2. Scanning and editing of photos, background and other graphics element.
3. Chart development.
4. Map prepration
5. Text manipulation
6. 3-D graphics
7. Computer animation