COMPUTER GRAPHICS

Assignment-1

Submitted By -

Shivani Bansal.

06220802816

ECE-B

62-ECE-B-16

Submitted To -

Ms. Mugdha

1 Computer graphics is an art of drawing pictures, lines, charts 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. Basically there are two types of computer graphics namely

① Interactive Computer Graphics.

② Non-Interactive computer graphics.

The following are considered graphics applications.

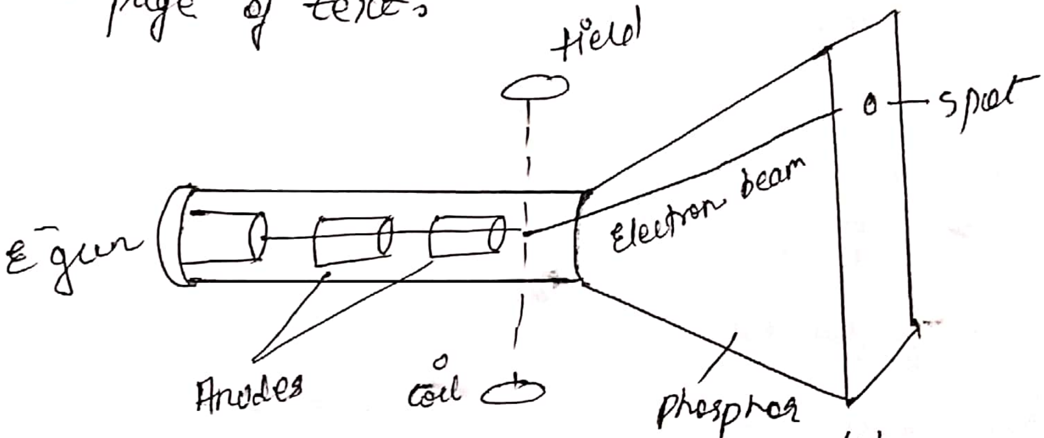
Paint programs:- Allow you to create rough freehand drawing. The image are stored as bit maps and can be easily edited.

Illustration/design programs - supports more advanced features than paint program, particullary for drawing curved lines.

Animation software - Enables you to chain and sequence a series of Images to simulate movement

n2 A cathode ray Tube consists of several basic components. The electron gun generates a narrow beam of electrons. The anodes accelarate the electrons. Deflecting coils produce an extremly low frequency electromagnetic field that allows for constant adjustment of the direction of the electron beam. These are two sets of deflecting coils: horizontal and vertical. The intensity of the beam can be when it strikes the phosphor coated screen.

To produce an image on the screen, complex signals are applied to the deflecting coils and also to the apparatus that controls the intensity of the electron beam. This causes the spot to race across the screen from right to left, and from top to bottom in a sequence of horizontal lines called raster. As viewed from the front of the CRT, the spot moves in a pattern similar to the way your eyes move when you read a single column page of text.



CRT

This causes the spot to race across the screen from right to left, & from top to bottom, in a sequential way.

A1 3

(a) Aspect ratio - It is the ratio of the number of X pixels to the Y pixels. The standard aspect ratio for PCs is 4:3 & 5:4

(b) Look up table - It is separate memory block created containing 256 different colours. The intensity values stored therein are not constrained within the range of 0-3 for blue and 0-7 for red and green. The intensity value finally results in having intensity 0-296 each. It can be reloaded any time with different colour combination.

(c) Refresh rate - It is the no. of times a display's image is repainted or refreshed per second. The refresh rate is expressed in Hz so a refresh rate of 75 means the image is refreshed 75 times in a second.

(d) Raster display - There electron beam is ~~at~~ screen, from top to bottom covering one row at a time, Here refreshing is done at the rate of 60-80 frams per second.

(e) Random ~~dt~~ file - A display file is a series of graphics commands that define an output image. The image is created by executing the commands to combine various primitives.

(f) Interlacing - It is where the horizontal lines of a video display are updated on add & even lines alternately.

Ans4 Step-1 - Start Algorithm

Step-2 - Declare variable $x_1, x_2, y_1, y_2, d, i_1, i_2, dx, dy$

Step-3 - Enter value of x_1, y_1, x_2, y_2 where x_1, y_1 are coordinates of starting points and x_3, y_3 are coordinates of ending points

Step-4 - calculate $dx = x_2 - y_1$

$dy = y_2 = y_1$

$i_1 = 2 * dy$

$i_2 = 2 * (dy - dx)$

$d = i_1 - dx$

Step-5 - consider (x, y) is starting point & x_{end} as

Scanned with CamScanner

maximum possible value of x. If $dx < 0$ then $x = x_2$, $y = y_2$, $x_{end} = x_1$ If $dx > 0$ then $x = x_1$, $y = y_1$ & $x_{end} = x_2$

Step 6 - Generate points of (x, y) coordinates

Step 7 - Check if whole line is generated. If $x >= x_{end}$ stop.

Step 8 - Calculate coordinate of next pixel

If $d < 0$ then $d = d + i_1$

$d \geq 0$, $d = d + x_2$

Increment $y = y + 1$

Step 9 - Increment $x = x + 1$

Step 10 - Draw a point of latest (x, y) coordinates

Step 11 - Go to step 7

Step 12 - End of algorithm.

Bresenhem's algo is more efficient & accurate then DDA algo since only integer values is included. It also involves addition & subtraction making it faster and values are rounded off to the closest integer value as well.

Ans 5 Bresenham's circle generating algorithm →

1. Get the coordinates of the center of the circle and radius & store them in p, q and x respectively. set $P = 0$, $Q = x$.
2. set decision parameter $p = 3 - 2x$
3. Repeat through step & while $P \leq Q$
4. Call draw circle X, Y, P, Q
5. Increment the value of P
6. If $D < 0$ then $D = D + 4P + 6$

(7) Else set $x = x-1$, $D = D + 4P - Q + 10$
(8) Call draw circle X, Y, P, Q

Q4 6 Size $= \frac{640 \times 400 \times 16}{1024 \times 8} = 500$ KB

Ans 7 $x_1 = 0$, $y_1 = 0$

$x_2 = 17$, $y_2 = 12$

$dx = x_2 - x_1 = 17$

$dy = y_2 - y_1 = 12 - 0 = 12$

$I_1 = 2 * \Delta y = 24$

$I_2 = 2 * (\Delta y - \Delta x) = 2 * (12 - 17) = -10$

$d = I_1 - \Delta x = 24 - 17 = 7$

df = I_1 or I_2	x	y
7	1	1
-3	2	1
21	3	2
11	4	3
1	5	4
-9	6	4
15	7	5
5	8	6
19	10	7
9	11	8
-1	12	8
23	13	9
13	13	10
7	16	11
17	17	12

Scanned with CamScanner

Q. 8 (a) frame buffer size with 12 bits per pixel

for 640 X 480 = $\frac{640 \times 480 \times 12}{8}$ = ~~406~~

= 460800 bytes

for 1280 X 1024 = $\frac{1280 \times 1024 \times 12}{8}$

= 1966080 bytes

for 2560 X 2048 = $\frac{2560 \times 2048 \times 12}{8}$

= 7864320 bytes.

A. 9

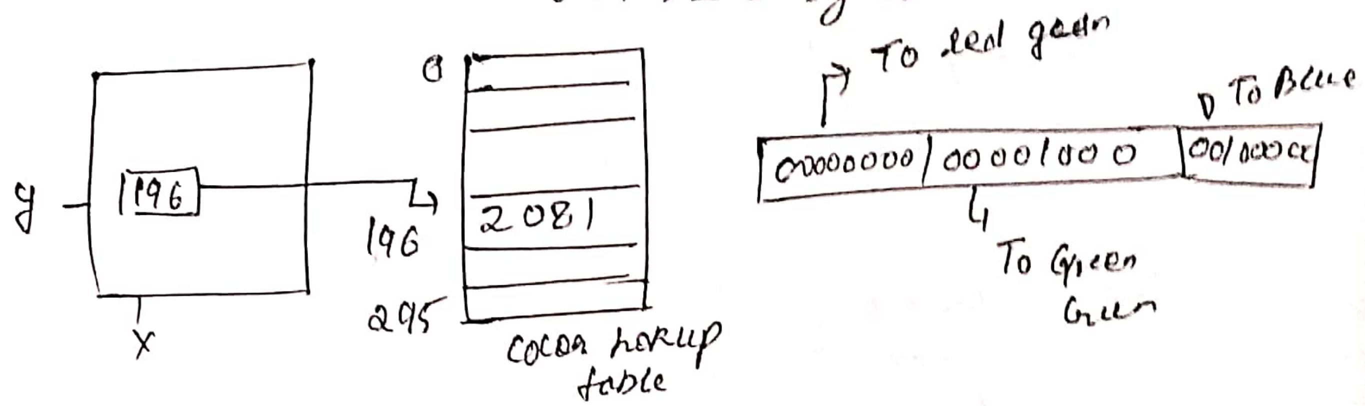


Fig A colour Lookup table with 24 bits per entry accessed from a frame buffer with 8 bits per pixel.

Above figure, illustrates a possible scheme for storing colour values in a color lookup table where frame buffer are now used as indices on the color's table. Each pixel can reference any one of the 256 table position & each entry in the table uses 24 bits to specify an RGB positions.

A. 10 24 bits are to specify on RGB pixel location (x, y) systems employing this particular lookup table would allow a user to select any 256 colors for simultaneous display from a palatte of nearly 17 million colors. Compared to a full color system

Ans 11 A window characterizes a rectangular region in world directions. You characterize a window with a GWINDOW explanation. You can characterise the window to be bigger than an indistinguishable size from or little than the real scope of data values. A viewport characteristics in standardised directions a rectangular region on the display gadgets where the picture of the information shows up. The viewport is the size of the screen while window is the size of the program.

Normalised device coordinates are used in defining views of objects. In particular they are used for specifying view ports, image transformation and input from stroke and locator devices.

Ans 12 Point clipping is used to determine whether the point is inside the window or not. For this following conditions are checked.

(i) $x \le x_{max}$ (ii) $x \ge x_{min}$ (iii) $y \le y_{max}$ (iv) $y \ge y_{min}$

The (x, y) is coordinate of the point. If anyone from the above inequalities is false, then the point will fall outside the window and will not be considered to be visible.

Ans 13 To determine the general form of the scaling matrix w.r.t a fixed point $P(h, k)$ we have to perform 3 steps -

① Translate $P(h, k)$ at the origin by performing translation (T_1)

② Scale the point or object by performing scaling (S)

Ans 3. Translate the origin back by performing reverse translation (T_2) ∴ General form is a composition of $T_1 S T_2$ matrices

$$S_p = T_1 S T_2$$

$$S_p = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ -h & k & 1 \end{bmatrix} \begin{bmatrix} S_x & 0 & 0 \\ 0 & S_y & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ h & k & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & S_y & 0 \\ -S_x h + h & S_y k + k & 1 \end{bmatrix}$$

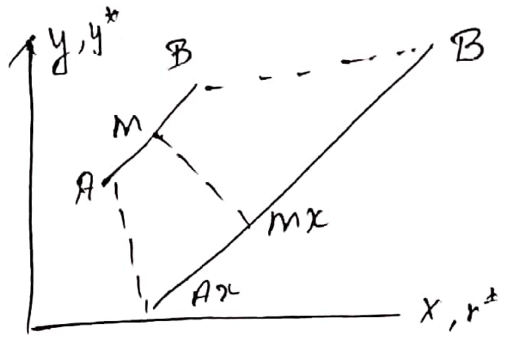
Ans 14 A coordinate system that algebraically beats all points in the projective plane equal. eg. the standard homogeneous coordinates of a point P in the projective plane are of the form $(x, y, 1)$ if P is a point in the Euclidean plane $z = 1$. Homogeneous coordinates are widely used in computer graphics because they enable affine & projective transformations to be described as matrix manipulations in a coherent way.

Ans 15 Let $A = [x_1 y_1]$, $B = [x_2 y_2]$

$$[T] = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

Transforming both sides

$$\begin{bmatrix} A \\ B \end{bmatrix} [T] = \begin{bmatrix} x_1 & y_1 \\ x_2 & y_2 \end{bmatrix} \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$



$A^* = [x_1^* \; y_1^*] = [ax_1 + cy_1 \quad bx_1 + dy_1]$

$B = [x_2^* \; y_2^*] = [ax_1 + cy_2 \quad bx_2 + dy_2]$

mid point of A^*B^* is $[x_m^* \; y_m^*] = \left[\dfrac{a(x_1+x_2)}{2} + \dfrac{(y_1+y_2)}{2} \quad \dfrac{b(x_1+x_2)}{2} + \dfrac{d(y_1+dy_2)}{2} \right]$

$$[x_m \; y_m] = \left[\frac{x_1+x_2}{2} \quad \frac{y_1+y_2}{2} \right]$$

using $[T]$

$$[x_m \; y_m][T] = \left[\frac{x_1+x_2}{2} \quad \frac{y_1+y_2}{2} \right] \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

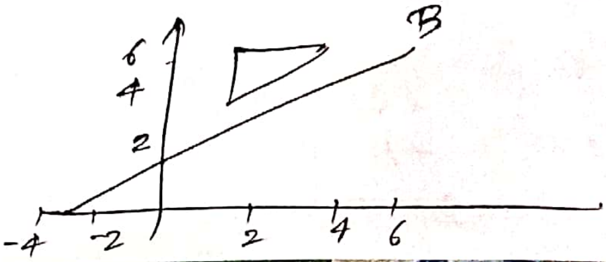
$$= \left[a\frac{(x_1+x_2)}{2} + c\frac{(y_1+y_2)}{2} \quad b\frac{(x_1+x_2)}{2} + d\frac{(y_1+y_2)}{2} \right]$$

i.e It means mid point AB transforms into mid point of $A^* B^*$. Thus, one to one correspondence b/w points on the line AB & A^*B^* is possible.

Ans 16 $y = \frac{1}{2}(x+y)$ Position vector are $A = [2 \; 4 \; 1]$

$B = [4 \; 6 \; 1]$

$C = [2 \; 6 \; 1]$



$$[T] = [T_{RF}][T_O][Ref][R_O]^{-1}[T_F]^{-1}$$

$$T_r = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & -2 & 1 \end{bmatrix}$$

$$[R_\theta] = \begin{bmatrix} \frac{2}{\sqrt{5}} & -1/\sqrt{5} & 0 \\ 1/\sqrt{5} & 2/\sqrt{5} & 0 \\ 0 & 0 & 1 \end{bmatrix} \qquad [Ref] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$[R_O]^{-1} = \begin{bmatrix} 2/\sqrt{5} & 1/\sqrt{5} & 0 \\ -1/\sqrt{5} & 2/\sqrt{5} & 0 \\ 0 & 0 & 1 \end{bmatrix} \qquad [T_F]^{-1} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 2 & 1 \end{bmatrix}$$

$$[T] = \begin{bmatrix} 3/5 & 4/5 & 0 \\ 4/5 & -3/5 & 0 \\ -8/5 & 16/5 & 1 \end{bmatrix}$$

A 17

$W_{xmin} = 2 \qquad W_{ymin} = 2$

$W_{xmax} = 6 \qquad W_{ymax} = 10$

Viewport

$V_{xmin} = 0 \qquad V_{ymin} = 0$

$V_{xmax} = 1 \qquad V_{ymax} = 1$

$$S_x = \frac{V_{xmax} - V_{xmin}}{W_{xmax} - W_{xmin}} = \frac{1-0}{6-2} = 1/4$$

$$S_y = \frac{V_{ymax} - V_{ymin}}{W_{ymax} - W_{ymin}} = \frac{1-0}{10-2} = \frac{1}{8}$$

$$W = \begin{bmatrix} 1/4 & 0 & -1/2 \\ 0 & 1/8 & -1 \\ 0 & 0 & 1 \end{bmatrix}$$

A18 Region code

$A(2,11) \to 1001$ & $B(9,2) \to 0100$

Slope of AB $m = \frac{y_2 - y_1}{x_2 - x_1} = -\frac{9}{7}$

Now x lies outside the window since it has slope less than 1.

$$y = y_1 + m(x - x_1)$$
$$= 9.71$$

$$x = x_1 + \frac{(y - y_1)}{m} = 3.55$$

~~x~~ IIly, end point $x = 7.44$ & $y = 4$

∴ clipped line is $[(3.55, 9), (7.44, 4)]$.

A 19

$$R_x(\theta) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta & 0 \\ 0 & \sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$R_y(\theta) = \begin{bmatrix} \cos\theta & 0 & \sin\theta & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\theta & 0 & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

A 20 Bezeir curve can be represented as

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

where P_i is the set of points & $B_i^n(t)$ reprents the Benstein polynomical which are given by

$$B_i^n(t) = \binom{n}{i} (1-t)^{n-i} t^i$$

when n is polynomial degree.

Scanned with CamScanner

Ans 2)

$$P(u) = [x(u), y(u)] = \sum_{k=0}^{n} \frac{n!}{(n-k)!\,k!} u^k (1-u)^{n-k} P_k$$

$$x(0) = \sum_{k=0}^{3} \frac{3!}{(3-k)!\,k!} u^k (1-u)^k x_k$$

$$= 1u^0 (1-u)^3 x_0 + 3u(1-u)x + 3u^2(1-u)x_2 + u^3 x_3$$

$$x(u) = 180(1-u)^9 + 300u(1-u)^2 + 900u^2 + 50u^3.$$

Point	u	$x(u), y(u)$
1	0	50, 180
2	0.1	113.9, 163.67
3	0.2	183.2, 199.76
4	0.3	254.3 163.89
5	0.4	323.9, 177.69
6	0.5	387.5, 178.75
7	0.6	442.4, 180.72
8	0.7	484.7, 173.21
9	0.8	510.8, 151.84
10	0.9	517.1, 112.84
11	1	500, 50

Scanned with CamScanner