Assignment No 2

Problem Statement:
Implement DDA and Bresenham line drawing algorithm to draw: i) Simple Line ii) Dotted Line iii) Dashed Line iv) Solid line ; using mouse interface Divide the screen in four quadrants with center as (0, 0). The line should work for all the slopes positive as well as negative.

Objective:
1. To Learn DDA line drawing algorithm
2. To learn Bresenham line drawing algorithm

Outcome:
To understand how to draw line using these algorithms

CO Relevance: CO2

PO/PSOs Relevance: PO1, PO2, PO5, PO6

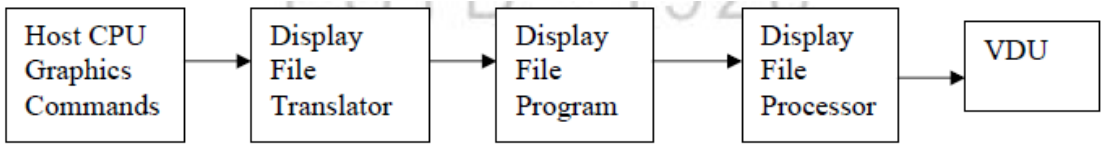
Theory Concepts :

Raster Scan Display:

When the beam reaches the bottom of the screen, it is made OFF and rapidly retracted back to top left to start again. A display produced in this way is called **Raster Scan Display.** The refresh process is independent of the complexity of the image.Sequences of operations performed in raster scan are performed through following components.
a) Graphics Commands.
b) Display Conversion (Scan Conversion)
c) Frame buffer.
d) Display Controller
e) Visual Display Unit (VDU).

Characteristics:
i. It is very cost effective, even inexpensive.
ii. It has availability of large memory and has high refresh rate.
iii. It has ability to display areas filled with solid colors and patterns.

Block Diagram:



Vector Scan Display:
In vector scan display, the beam is moved between the endpoints of graphics primitives.
It flickers when the number of primitives in the buffer becomes too large.

Characteristics:
i. This is also called as **Random Scan Display.**
ii. It draws a continuous and smooth line.
iii. It only draws lines and characters and is more costly.

Line:
It is the path between two end points. Any point (x, y) on the line must follow the line equation:
Point is the fundamental element of the picture representation. It is nothing but the position in a plane defined as either pairs or triplets of numbers depending whether the data are two or three dimensional. Thus (x1, y1) or (x1, y1, z1) would represent a point two or three dimensional space. Two points used to specify line by below equation

y = m * x + b, where
– **m is the slope of the line.**
– **b is a constant that represent the intercept on y-axis.**

If we have two end points, (x0, y0) and (x1, y1), then the **slope** of the line (**m**) between those points can be calculated as:

$m = \Delta y / \Delta x = (y1 – y0) / (x1 – x0)$

Draw a line with the help of line equation is very time consuming because it's required lots of calculation. A cathode ray tube (CRT) raster display is considered a matrix of discrete finite area cells (pixels), it is not possible to draw a straight line directly from one point to another. The process of determining which pixels provide the best approximation to the desired line is called rasterization.

To draw a line, we can use two algorithms:

i) DDA (Digital Differential Analyzer)/Vector Generation Algorithm.
ii) Bresenham's Line Algorithm.

DDA Line Drawing Algorithm:

Digital Differential Analyzer (DDA) algorithm is the simple line generation algorithm. It is the simplest algorithm and it does not require special skills for implementation. It is a faster method for calculating pixel positions than the direct use of equation y=mx + b. It eliminates the multiplication in the equation by making use of raster characteristics, so that appropriate
increments are applied in the x or y direction to find the pixel positions along the line path.

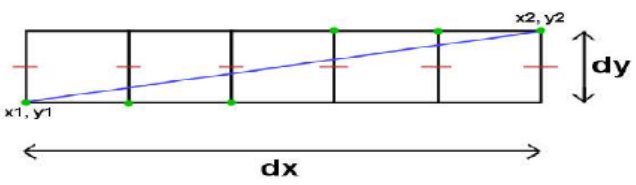
Disadvantages of DDA Algorithm
1. Floating point arithmetic in DDA algorithm is still time-consuming.
2. The algorithm is orientation dependent. Hence end point accuracy is poor.

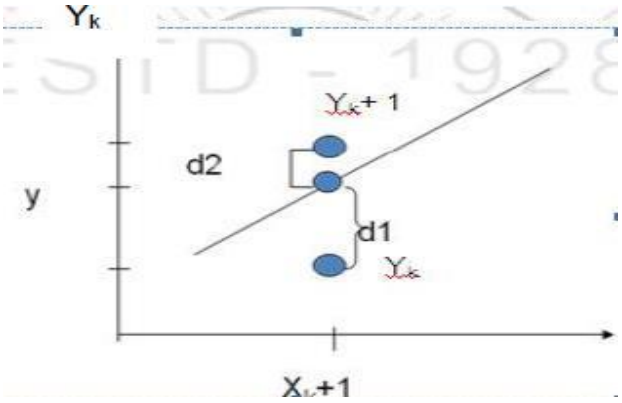
Algorithm for DDA Line:

1. Start
2. Declare the variables and gDriver = DETECT and gMode
3. Initialize the graphics mode using initgraph( )
4. Read the line end points (x1,y1) and (x2,y2) such that they are not equal.
5. Calculate the difference between two end points.
   dx = x1 – x2
   dy = y1 - y2
6. If dx >= dy and x1 <= x2 then //gentle slope lines
   Increment x by 1
   Increment y by m
   Else if dx >= dy and x1 > x2 then //gentle slope lines
   Increment x by -1
   Increment y by -m
   Else if dx < dy and y1 <= y2 then //steep/sharp slope lines
   Increment x by 1/m
   Increment y by 1
   Else if dx < dy and y1 > y2 then //steep/sharp slope lines
   Increment x by -1/m
   Increment y by -1
7. plot x increment and y increment
8. repeat step 6 until other end point is reach
9. Closegraph
10. Stop.

Bresenham's Line Drawing Algorithm:

Bresenham's is another incremental scan-conversion algorithm. It is named AfterJack Bresenham who worked at IBM for 27 years before entering academics. He had developed this algorithm in early 1960 at IBM.The biggest advantage of this algorithm is that it uses only integer calculations.When we have a point (xk, yk), then we must decide whether to draw the point (xk+1, yk) or (xk+1, yk+1).Note that, at all cases, we move to xk+1, still we must decide to move to yk or yk+1. The increment in the other variable is determined by examining the distance between the actual line location and the nearest pixel. The distance is called **decision variable** or the **error**.





As shown in figure the line does not pass through all raster points. It is passes through raster point (0,0). It is seen that the intercept of line Xk+1 is closer to the line Yk+1 than to the line Yk..

Algorithm for Bresenham's Line:

1. Start
2. Declare the variables and gDriver = DETECT and gMode
3. Initialize the graphics mode using initgraph( )
4. Read the line end points (x1,y1) and (x2,y2) such that they are not equal.
5. Calculate dx=x2-x1 and dy=y2-y1
6. x=x1 and y=y1 [Initialize starting point]
7. e=2*dy-dx [Initialize value of decision variable]
8. i=1
9. plot(x,y)
10. while(e>=0)
    {
    y=y+1
    e=e - 2*dx
    }
    x=x+1
    e=e + 2*dy
11. i=i+1
12. if(i<=dx)then go to step 9
13. Closegraph
14. Stop.

Output:

(Execute the program and attach the printout here)

Conclusion:

In This way we have studied that how to draw a line using DDA and Bresenham's

Viva Questions:

1.Explain DDA
2.Explain Bresenham
3.Difference Between DDA and Bresenham

Date:	
Marks obtained:	
Sign of course coordinator:	
Name of course Coordinator :	