



**K. J. Somaiya College of Engineering,
Mumbai-77**

Somaiya Vidyavihar University

Batch: D-2 **Roll No.:** 16010122151

Experiment No. 04

TITLE: Draw the Following polygon/shape/curve.

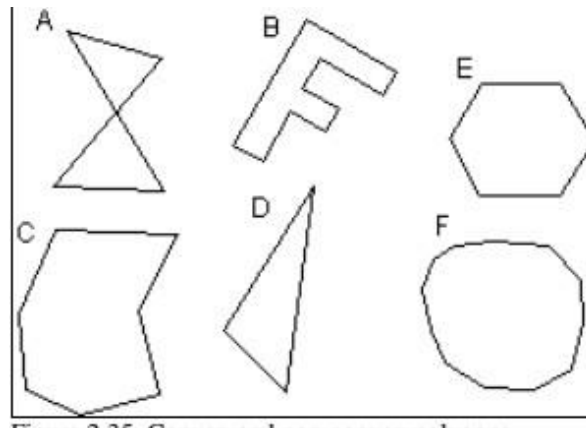
a. Bresenham Circle Drawing Algorithm.

b. Other shapes

AIM:

a. Generate the Circle using Bresenham Circle Drawing Algorithm

b. Draw polygon shown in following figure



Expected OUTCOME of Experiment:

Understand the basic concepts of computer graphics and OpenGL.

Books/ Journals/ Websites referred:

<https://www.gatevidyalay.com/bresenham-circle-drawing-algorithm/>

Algorithm:

a. Bresenham's Circle Drawing Algorithm:

1. : Start Algorithm
2. : Declare p, q, x, y, r, d variables. p, q are coordinates of the centre of the circle.
r is the radius of the circle



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3. : Enter the value of r
4. : Calculate $d = 3 - 2r$
5. : Initialize $x = 0$ & $nbsy = r$
6. : Check if the whole circle is scan converted. If $x \geq y$, stop
7. Plot eight points by using concepts of eight-way symmetry. The centre is at (p, q) . Current active pixel is (x, y) .
putpixel $(x+p,$
 $y+q)$ putpixel
 $(y+p, x+q)$
putpixel $(-y+p,$
 $x+q)$ putpixel $(-$
 $x+p, y+q)$
putpixel $(-x+p,$
 $-y+q)$ putpixel $(-$
 $y+p, -x+q)$
putpixel $(y+p, -$
 $x+q)$ putpixel
 $(x+p, -y-q)$
8. : Find location of next pixels to
be scanned
If $d < 0$
then $d = d +$
 $4x + 6$
increment x
 $= x + 1$ If d
 ≥ 0
then $d = d + 4(x -$
 $y) + 10$ increment
 $x = x + 1$
decrement $y = y -$
1
9. : Go to step 6
10. : Stop Algorithm



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Implementation details:

Bresenham Circle Drawing Algorithm

```
#include <GL/glut.h>
#include <cmath>
#include <iostream>

const int w = 200, h = 200;

void Line(int x1, int y1, int x2, int y2) {
    x1 = 2 * x1 / w - 1;
    y1 = 2 * y1 / h - 1;
    x2 = 2 * x2 / w - 1;
    y2 = 2 * y2 / h - 1;

    glBegin(GL_LINES);
    glVertex2f(x1, y1);
    glVertex2f(x2, y2);
    glEnd();
}

void bresenham(int xc, int yc, int r) {
    int x = 0;
    int y = r;
    int d = 3 - 2 * r;

    while (x <= y) {
        int a = x, b = y;

        Line(a + 100, b + 100, x + 100, y + 100);
        Line(b + 100, a + 100, y + 100, x + 100);
        Line(-a + 100, b + 100, -x + 100, y + 100);
        Line(-b + 100, a + 100, -y + 100, x + 100);
        Line(-a + 100, -b + 100, -x + 100, -y + 100);
        Line(-b + 100, -a + 100, -y + 100, -x + 100);
        Line(a + 100, -b + 100, x + 100, -y + 100);
        Line(b + 100, -a + 100, y + 100, -x + 100);

        if (d < 0) {
            x++;
            d = d + 4 * x + 6;
        } else {
            y--;
            d = d - 4 * y + 6;
        }
    }
}
```



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```
        x++;
        y--;
        d = d + 4 * (x - y) + 10;
    }
}

void display() {
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
    glLoadIdentity();
    glColor3f(0.0, 1.0, 1.0);
    bresenham(100, 100, 50);
    glutSwapBuffers();
}

void init() {
    glClearColor(0.0, 0.0, 0.0, 0.0);
    glMatrixMode(GL_PROJECTION);
    glLoadIdentity();
    gluOrtho2D(0.0, 500.0, 0.0, 500.0);
}

int main(int argc, char** argv) {
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_RGBA);
    glutInitWindowSize(400, 400);
    glutInitWindowPosition(0, 0);
    glutCreateWindow("OpenGL - Bresenham's Circle Drawing Algorithm");
    init();
    glutDisplayFunc(display);
    glutIdleFunc(display);
    glutMainLoop();
    return 0;
}
```

Polygon:

```
#include <GL/glut.h>
#include <vector>

using namespace std;

vector<vector<pair<float, float>>> polygons = {
```



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```
{ {50.00, 450.00}, {129.20, 423.10}, {24.50, 311.82}, {121.87,
306.70}},
{ {276.36, 443.61}, {191.43, 317.67}, {218.52, 300.00}, {250.00,
350.00}, {281.48, 332.32}, {292.47, 355.75}, {263.18, 371.12}, {282.95,
404.07}, {345.18, 373.32}, {359.10, 400.40}},
{ {350.00, 350.00}, {437.13, 348.54}, {461.29, 303.14}, {431.27,
259.21}, {352.93, 259.94}, {320.71, 304.6}},
{ {155.05, 227.96}, {37.9, 229.42}, {11.54, 147.42}, {28.38, 63.95},
{96.48, 47.84}, {157.98, 69.08}, {133.09, 150.35}},
{ {258.9, 239.89}, {172.97, 118.52}, {224.35, 58.28}},
{ {310.13, 182.28}, {350.89, 189.37}, {382.78, 189.37}, {404.93,
187.6}, {427.96, 181.4}, {447.45, 160.13}, {457.2, 125.58}, {449.23,
86.6}, {439.48, 54.71}, {412.02, 38.76}, {372.15, 37.87}, {339.37,
43.19}, {303.93, 58.25}, {288.87, 79.51}, {274.69, 136.21}, {280.01,
165.45}}
};

void polygon(const vector<pair<float, float>>& points) {
    glLineWidth(5.0);
    glBegin(GL_LINE_LOOP);
    for (const auto& point : points) {
        glVertex2f(point.first, point.second);
    }
    glEnd();
}

void draw() {
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
    for (size_t i = 0; i < polygons.size(); i++) {
        polygon(polygons[i]);
    }
}

void init() {
    glViewport(0, 0, 1500, 1500);
    glMatrixMode(GL_PROJECTION);
    glLoadIdentity();
    gluOrtho2D(0.0, 500, 0.0, 500);
    glMatrixMode(GL_MODELVIEW);
    glLoadIdentity();
}

void showScreen() {
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
    glLoadIdentity();
```



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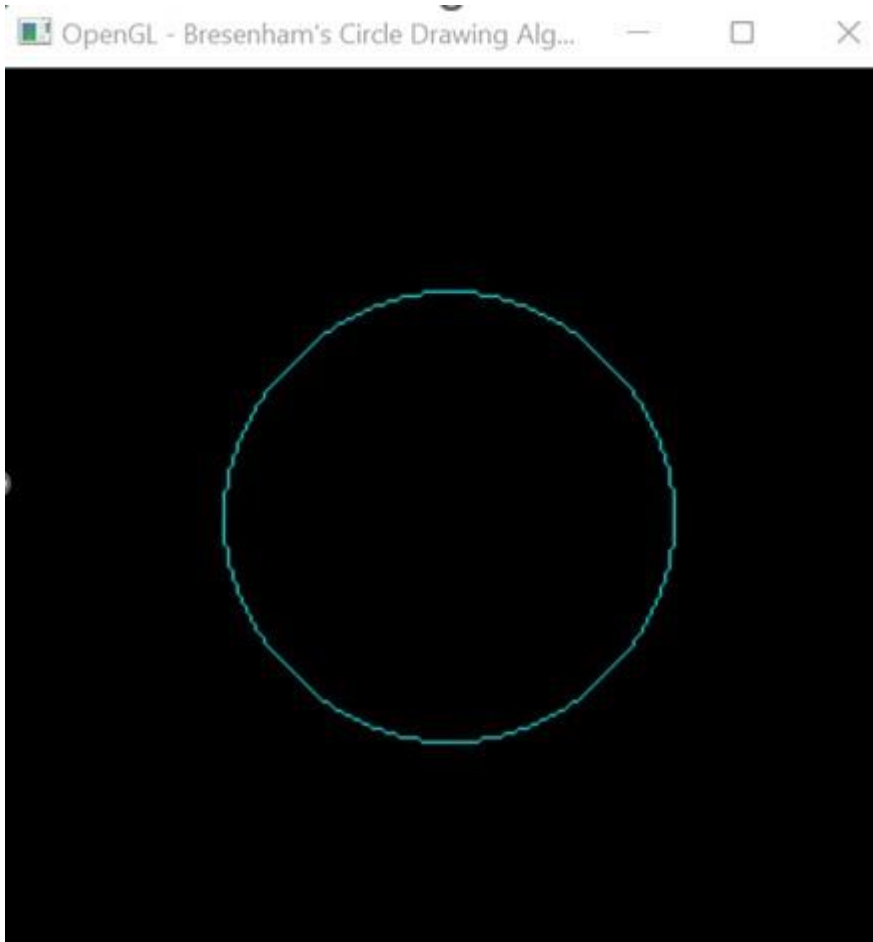
```
init();  
draw();  
glutSwapBuffers();  
}  
  
int main(int argc, char** argv) {  
    glutInit(&argc, argv);  
    glutInitDisplayMode(GLUT_RGBA);  
    glutInitWindowSize(1500, 1500);  
    glutInitWindowPosition(0, 0);  
    glutCreateWindow("Polygon");  
    glutDisplayFunc(showScreen);  
    glutMainLoop();  
    return 0;  
}
```

Output(s) (final edited screen shot):



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Screenshots from VLab:

Pre Test

If the circle has to be drawn with the radius R, then some point will lie on the X-axis and Y-Axis.

- ☒ a : True
☐ b : False

If the circle has to be drawn with the radius R, then some point will have less x-coordinate and some point will have greater x-coordinates than respective y-coordinate.

- ☐ a : False
☒ b : True

If the circle has to be drawn with the center (20,20) and radius 10, then the point (20,30) will lie on the circle.

- ☐ a : False
☒ b : True

If the circle has to be drawn with the center (20,20) and radius 10, then the point (20,10) will lie on the circle.

- ☐ a : False
☒ b : True

If the circle has to be drawn with the center (20,20) and radius 10, then the point (30,20) will lie on the circle.

- ☒ a : True
☐ b : False

Submit Quiz

5 out of 5

Draw a Circle having center at (7,6) and a radius of 4px using Bresenham Circle Drawing Algorithm

Start Simulator Clear Canvas

4. Mark the calculated co-ordinates on the canvas below

0,0	1,0	2,0	3,0	4,0	5,0	6,0	7,0	8,0	9,0	10,0	11,0	12,0	13,0	14,0	15,0
0,1	1,1	2,1	3,1	4,1	5,1	6,1	7,1	8,1	9,1	10,1	11,1	12,1	13,1	14,1	15,1
0,2	1,2	2,2	3,2	4,2	5,2	6,2	7,2	8,2	9,2	10,2	11,2	12,2	13,2	14,2	15,2
0,3	1,3	2,3	3,3	4,3	5,3	6,3	7,3	8,3	9,3	10,3	11,3	12,3	13,3	14,3	15,3
0,4	1,4	2,4	3,4	4,4	5,4	6,4	7,4	8,4	9,4	10,4	11,4	12,4	13,4	14,4	15,4
0,5	1,5	2,5	3,5	4,5	5,5	6,5	7,5	8,5	9,5	10,5	11,5	12,5	13,5	14,5	15,5
0,6	1,6	2,6	3,6	4,6	5,6	6,6	7,6	8,6	9,6	10,6	11,6	12,6	13,6	14,6	15,6
0,7	1,7	2,7	3,7	4,7	5,7	6,7	7,7	8,7	9,7	10,7	11,7	12,7	13,7	14,7	15,7
0,8	1,8	2,8	3,8	4,8	5,8	6,8	7,8	8,8	9,8	10,8	11,8	12,8	13,8	14,8	15,8
0,9	1,9	2,9	3,9	4,9	5,9	6,9	7,9	8,9	9,9	10,9	11,9	12,9	13,9	14,9	15,9
0,10	1,10	2,10	3,10	4,10	5,10	6,10	7,10	8,10	9,10	10,10	11,10	12,10	13,10	14,10	15,10
0,11	1,11	2,11	3,11	4,11	5,11	6,11	7,11	8,11	9,11	10,11	11,11	12,11	13,11	14,11	15,11

Iteration 1

Set P :

Set Q :

Enter Decision parameter

Is P <= Q ?

Check

Pixels

(X + P) :	<input type="text" value="7"/>	(Y + Q) :	<input type="text" value="10"/>
(X - P) :	<input type="text" value="7"/>	(Y + Q) :	<input type="text" value="10"/>
(X + P) :	<input type="text" value="7"/>	(Y - Q) :	<input type="text" value="2"/>
(X - P) :	<input type="text" value="7"/>	(Y - Q) :	<input type="text" value="2"/>
(X + Q) :	<input type="text" value="11"/>	(Y + P) :	<input type="text" value="6"/>
(X - Q) :	<input type="text" value="11"/>	(Y + P) :	<input type="text" value="6"/>
(X + Q) :	<input type="text" value="3"/>	(Y - P) :	<input type="text" value="6"/>
(X - Q) :	<input type="text" value="3"/>	(Y - P) :	<input type="text" value="6"/>

Check Pixels

Is value of P incremented : YES ☒ NO ☐

Is value of Q decremented : YES ☒ NO ☐

Check



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If the circle has to be drawn with the center (0,0) and radius 10, then what will be initial decision parameter?

- ☐ a : -7
☐ b : 1
☐ c : 20
☒ d : -17

If the circle has to be drawn with the center (0,0) and radius 10, then which point will be plotted after (0,10)?

- ☐ a : (2,10)
☒ b : (1,10)
☐ c : (2,9)
☐ d : (3,9)

If the circle has to be drawn with the center (0,0) and radius 10, then which point will be plotted after (2,10)?

- ☐ a : (2,9)
☒ b : (3,10)
☐ c : (4,9)
☐ d : (3,9)

The center of the circle is at (0,0) the first point plotted is (0,10) then what is the radius of the circle?

- ☒ a : 10
☐ b : 7
☐ c : 17
☐ d : 5

The 8 - way symmetry can be performed against any one of the octant.

- ☒ a : True
☐ b : False
☐ c : Cannot say
☐ d :

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Conclusion and discussion:

Successfully learned and experienced bresenham's circle drawing algorithm and made some polygons using OPENGGL and cairo lib in python.

Date:

Signature of faculty in-charge

Post lab

Visit and explore and paste your screenshot



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<https://cse18-iiith.vlabs.ac.in/exp/rasterization-line/>
<https://cse18-iiith.vlabs.ac.in/exp/rasterization-polygon/>