Vidyavardhini's College of Engineering & Technology

Department of Artificial Intelligence and Data Science

Experiment No. 8
Topic: To implement Bezier curve for n control points.
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Date of Performance:
Date of Submission:

Experiment No. 8

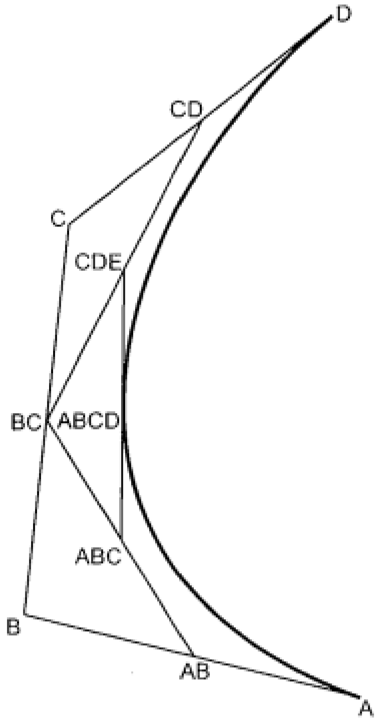
Aim: To implement Bezier curve for n control points. (Midpoint approach)

Objective:

Draw a Bezier curves and surfaces written in Bernstein basis form. The goal of interpolation is to create a smooth curve that passes through an ordered group of points. When used in this fashion, these points are called the control points.

Theory:

In midpoint approach Bezier curve can be constructed simply by taking the midpoints. In this approach midpoints of the line connecting four control points (A, B, C, D) are determined (AB, BC, CD, DA). These midpoints are connected by line segment and their midpoints are ABC and BCD are determined. Finally, these midpoints are connected by line segments and its midpoint ABCD is determined as shown in the figure –



The point ABCD on the Bezier curve divides the original curve in two sections. The original curve gets divided in four different curves. This process can be repeated to split the curve into smaller sections until we have sections so short that they can be replaced by straight lines.

Algorithm:

1) Get four control points say A(xa, ya), B(xb, yb), C(xc, yc), D(xd, yd).

2) Divide the curve represented by points A, B, C, and D in two sections.

xab = (xa + xb) / 2

yab = (ya + yb) / 2

xbc = (xb + xc) / 2

ybc = (yb + yc) / 2

xcd = (xc + xd) / 2

ycd = (yc + yd) / 2

xabc = (xab + xbc) / 2

yabc = (yab + ybc) / 2

xbcd = (xbc + xcd) / 2

ybcd = (ybc + ycd) / 2

xabcd = (xabc + xbcd) / 2

yabcd = (yabc + ybcd) / 2

3) Repeat the step 2 for section A, AB, ABC, ABCD and section ABCD, BCD, CD, D.

4) Repeat step 3 until we have sections so that they can be replaced by straight lines.

5) Repeat small sections by straight lines.

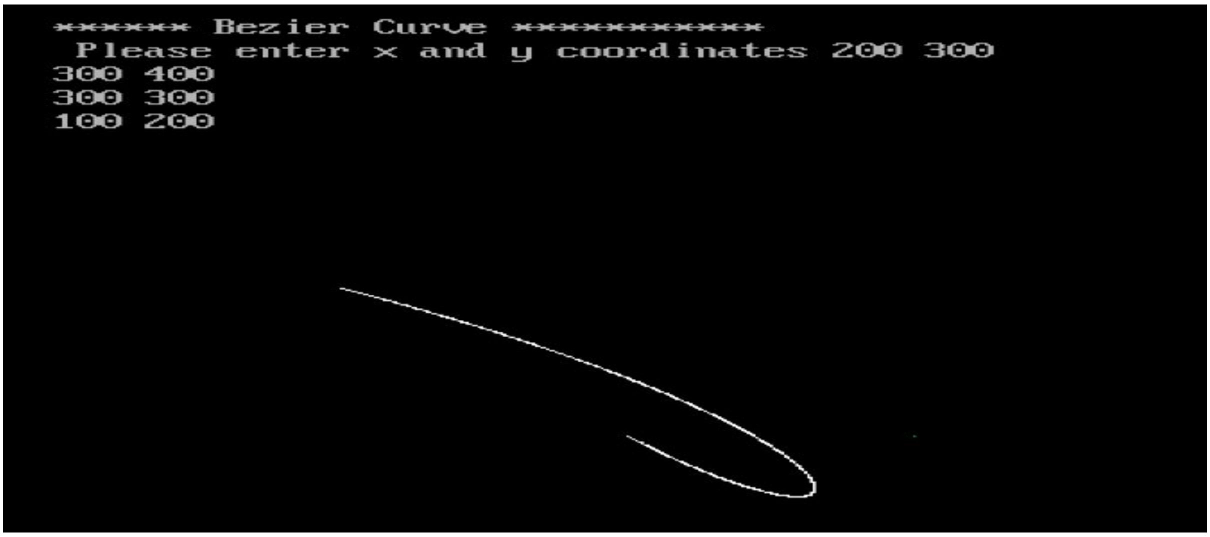
6) Stop.

Program:

```
#include<graphics.h>
#include<math.h>
#include<conio.h>
#include<stdio.h>
void main()
{
int x[4],y[4],i;
double put_x,put_y,t;
int gr=DETECT,gm;
initgraph(&gr,&gm,"C:\\TURBOC3\\BGI");
printf("\n****** Bezier Curve ***********");
printf("\n Please enter x and y coordinates ");
  for(i=0;i<4;i++)
   {
    scanf("%d%d",&x[i],&y[i]);
    putpixel(x[i],y[i],3);
   }

  for(t=0.0;t<=1.0;t=t+0.001)
   {
put_x = pow(1-t,3)*x[0] + 3*t*pow(1-t,2)*x[1] + 3*t*t*(1-t)*x[2] +           pow(t,3)*x[3]; // Formula to draw
curve
put_y =  pow(1-t,3)*y[0] + 3*t*pow(1-t,2)*y[1] + 3*t*t*(1-t)*y[2] +   pow(t,3)*y[3];
putpixel(put_x,put_y, WHITE);
}
 getch();
 closegraph();
}
```

Output:



```
******* Bezier Curve *************
 Please enter x and y coordinates 200 300
300 400
300 300
100 200
```

Conclusion – Comment on

1. Difference from arc and line

2. Importance of control point

3. Applications

Difference from arc and line: In Bezier curves, arcs and lines are distinct mathematical constructs used to represent and define different shapes and paths. The lines are straight paths, arcs represent segments of circles or ellipses, and Bezier curves are flexible parametric curves defined by control points, allowing a wide range of shapes and curves to be represented.

Importance of control points: Control points play a crucial role in defining the shape and characteristics of Bezier curves in computer graphics and design. Control points are essential in Bezier curves as they grant designers and artists control over the curve's shape, smoothness, and trajectory, allowing for versatile and flexible design possibilities in computer graphics, animation, and design applications.

Applications: Bezier curves, due to their versatility and ability to create various shapes and curves, find applications across a wide range of fields in computer graphics, design, engineering, and more. Some of the prominent applications include:

1. Animation and Motion Graphics: In animation software, Bezier curves are used to define motion paths for animated elements, allowing for smooth and controlled movement of objects or characters.
2. Industrial Design: Bezier curves play a significant role in industrial design, helping designers create complex surfaces and shapes for products such as cars, furniture, and consumer goods.
3. 3D Modeling and Rendering: In 3D modeling software, Bezier curves are used to create paths for animation, guide hair and particle systems, and define profiles for shapes and surfaces.