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PERFORMING AND PRACTICING CURVE GENERATION IN COMPUTER GRAPHICS CLASSES

Yusupova Nazokat Sattiyevna
Ass. Andijan Institute of Agriculture and Agrotechnologies,
Department of Electricity and Pumping Station Use.

Ganiyev Otabek Obidjon ugli
St.Teacher Andijan Institute of Agriculture and Agrotechnologies,
Department of Electricity and Pumping Station Use.

Komilov Valijon Mirodiljon ugli
1- course QXM. Andijan Institute of Agriculture and
Agrotechnologies, Department of Electricity and Pumping Station Use.

A B S T R A C T	K E Y W O R D S
Creating images of objects, storing them, processing and describing them in imaging devices is one of the most difficult and basic problems of the computer. When the computer is not assigned any tasks, that is, even when it is idle, it reproduces the image that should be displayed on its screen dozens of times per second.	Computer graphics, curves, implicit curves, bazier curves.

Curves are one of the most essential objects to create high-resolution graphics. While using many small polylines allows creating graphics that appear smooth at fixed resolutions, they do not preserve smoothness when scaled and also require a tremendous amount of storage for any high-resolution image. Curves can be stored much easier, can be scaled to any resolution without losing smoothness, and most importantly provide a much easier way to specify real-world objects.

All of the popular curves used in graphics are specified by parametric equations. Instead of specifying a function of the form $y = f(x)$, the equations $y = fy(u)$ and $x = fx(u)$ are used. Using parametric equations allows curves that can double back and cross themselves, which are impossible to specify in a single equation in the $y = f(x)$ case. Parametric equations are also easier to evaluate: changing u results in moving a fixed distance along the curve, while in the traditional equation form much work is needed to determine whether to step through x or y, and determining how large a step to take based on the slope.

In computer graphics, we often need to draw different types of objects onto the screen. Objects are not flat all the time and we need to draw curves many times to draw an object

A curve is an infinitely large set of points. Each point has two neighbors except endpoints. Curves can be broadly classified into three categories − explicit, implicit, and parametric curves.

Implicit Curves

Implicit curve representations define the set of points on a curve by employing a procedure that can test to see if a point in on the curve. Usually, an implicit curve is defined by an implicit function of the form −

fx,y = 0

It can represent multivalued curves multipleyvaluesforanxvalue. A common example is the circle, whose implicit representation is

x2 + y2 - R2 = 0

A mathematical function y = fx can be plotted as a curve. Such a function is the explicit representation of the curve. The explicit representation is not general, since it cannot represent vertical lines and is also single-valued. For each value of x, only a single value of y is normally computed by the function. Curves having parametric form are called parametric curves. The explicit and implicit curve representations can be used only when the function is known. In practice the parametric curves are used. A two-dimensional parametric curve has the following form −

P t = f t, g t or P t = x t, y t

The functions f and g become the x,y coordinates of any point on the curve, and the points are obtained when the parameter t is varied over a certain interval [a, b], normally [0, 1].

Bezier curve is discovered by the French engineer Pierre Bézier. These curves can be generated under the control of other points. Approximate tangents by using control points are used to generate curve. The Bezier curve can be represented mathematically as −

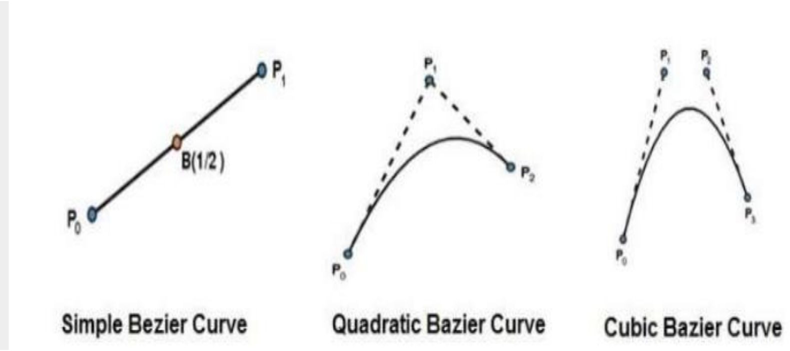
$$\sum_{k=0}^{n} P_i B_i^n(t)$$

Where p(i) is the set of points and B(ni(t) represents the Bernstein polynomials which are given by −

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

Where n is the polynomial degree, i is the index, and t is the variable.

The simplest Bézier curve is the straight line from the point P0 to P1. A quadratic Bezier curve is determined by three control points. A cubic Bezier curve is determined by four control points.



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