United Technical College, Bharatpur, Chitwan

Lab 4

Midpoint Ellipse Generation Algorithm

Date Assigned: Dec 05, 2022

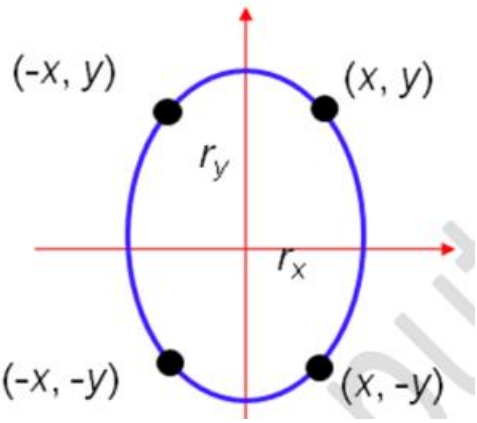
Date Due: Dec 12, 2022

Using Midpoint circle generation algorithm which is a variant of Bresenham's line algorithm, write a C-program to generate pixel activation list for drawing a ellipse with a given center of circle P(x,y) and a radius r?

Aim: To implement midpoint circle generation algorithm or Bresenham's circle algorithm for drawing an ellipse of given center (x,y) and major, minor axis r_x, r_y.

Description:

Basic Concept: In Ellipse, Symmetry between quadrants exists Not symmetric between the two octants of a quadrant Thus, we must calculate pixel positions along the elliptical arc through one quadrant and then we obtain positions in the remaining 3 quadrants by symmetry.



The next pixel is chosen based on the decision parameter. The required conditions are given in following algorithm.

Algorithm:

1. Input radius r_x and r_y and ellipse center (x_c,y_c). Obtain the first point on an ellipse centered on the origion as then set the coordinates for the first point on the circumference of a circle centered on the origin as:
   $$(x_0,y_0) = (0,r_y)$$
2. Calculate the initial value of the decision parameter as:
   $$P_0^1 = r_y^2 - r_x^2 r_y + \frac{1}{4} r_x^2$$
3. At each x_i position, starting at i=0, if $P_i^1<0$, the next point along the ellipse centered on (0,0) is (x_i+1,y_i) and
   $$P^1_{i+1} = P^1_i + 2\, r_y^2 x_{i+1} + r_y^2$$

Otherwise, the next point is (x_i+1,y_i-1) and

$$P^1_{i+1} = P^1_i + 2\ r_y^2 x_{i+1} - 2\ r_x^2 y_{i+1} + r_y^2$$

And continue until $2\ r_y^2 x >= 2\ r_x^2 y$

4. (x_0,y_0) is the last position calculated in region 1. Calculate the initial parameter in region 2 as
$$P^2_0 = r_y^2(x_0+1/2)^2 + r_x^2(y_0-1)^2 - r_x^2 r_y^2$$
5. At each y_i position, starting at i=0, if $p^2_i>0$, the next point along the ellipse centered on (0,0) is (x_i,y_i-1) and
$$P^2_{i+1} = P^2_i - 2\ r_x^2 y_{i+1} + r_x^2$$

   Otherwise, the next point is (x_i+1,y_i-1) and

$$P^2_{i+1} = P^2_i + 2\ r_y^2 x_{i+1} - 2\ r_x^2 y_{i+1} + r_x^2$$

   Use the same incremental calculation as in region 1. Continue until y=0.

6. For both regions determine symmetry points in the other three quadrants.
7. Move each calculated pixel positon (x,y) onto the elliptical path centered on (x_c,y_c) and plot the coordinate values

$$X = x+x_c \qquad y=y+y_c$$

Midpoint Ellipse Drawing Algorithm C Program: Students are expected to write C program in the lab.

Output: