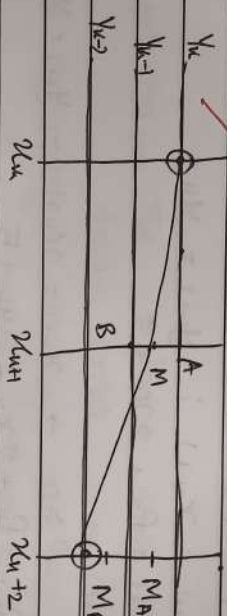


Experiment No - 3

Resource required → Turbo C, Printer, Printout, stationary.

Theory →

To draw a circle on the screen, the midpoint circle drawing approach is used where moving from current pixel (x_u, y_u) to the next coordinate to be plotted is either A or B. To choose between A and B the midpoint is calculated.



Equation of circle is,

$$x^2 + y^2 = r^2$$

$$\therefore x^2 + y^2 - r^2 = 0$$

(x-coordinates of midpoint are $M(x_{u+1}, y_{u-1/2})$)

$$P = f(M) = f(x_{u+1}, y_{u-1/2})$$

Initially the starting (x-coordinates of the circle is $(0, r)$)

So, the midpoint storing coordinate is $(1, r-1/2)$

$$P = 1^2 + (r-1/2)^2 - r^2$$

$$= 1 + r^2 + 1/4 - r - r^2 = 1 + 1/4 - r = \frac{5}{4} - r$$

$$\therefore P_{initial} = 1 - r$$

$$\therefore \frac{5}{4} - r \approx 1$$

Algorithm \rightarrow

Step 1: Read the coordinate (x_c, y_c) and radius r

Step 2: Initialize $x_u = 0$, $y_u = r$

Step 3: Find initial decision parameter,
 $P_u = 1 - r^2$

Step 4: Repeat step 5 onwards until $x < y$

Step 5: If $P < 0$

$$x_{u+1} = x_u + 1; \quad y_{u+1} = y_u;$$

$$P_{u+1} = P_u + 2x_u + 5$$

else

$$P \geq 0 \rightarrow x_{u+1} = x_u + 1; \quad y_{u+1} = y_u - 1$$

$$P_{u+1} = P_u + 2x_u - 2y_u + 5$$

$$\therefore P = (x_{u+1})^2 + (y_{u+1})^2 - r^2$$

If $P = f(u) = 0$ then, select A or B as next coordinate.

$P = f(u) < 1$, then select A

$P = f(u) > 1$, then select B

if A is selected then,

$$P_{\text{new}} = f(x_{u+1}, y_u) = f(x_u + 1, y_u - 1/2)$$

$$= (x_u + 1)^2 + (y_u - 1/2)^2 - r^2$$

$$= x_u^2 + 2x_u + 1 + (y_u - 1/2)^2 - r^2$$

$$= (x_u + 1)^2 + 2x_u + 3 + (y_u - 1/2)^2 - r^2$$

$$= (x_u+1)^2 + (y_u-1/2)^2 - r^2 + 2x_u + 3$$

$$i.e. P_{new} = P + 2x_u + 3$$

if R is selected then,

$$P_{new} = f(M_R) = f(x_u+2, y_u-3/2)$$

$$= (x_u+2)^2 + (y_u-3/2)^2 - r^2$$

$$= (x_u^2 + 1 + 2x_u + 3) + (y_u^2 + 9/4 - 3y_u) - r^2$$

$$= [(x_u+1)^2 + 2x_u + 3] + (y_u^2 - y_u + 1/4 - 2y_u + 9/4) - r^2$$

$$= (x_u+1)^2 + (y_u-1/2)^2 - r^2 + 2x_u + 3 - 2y_u + 8/4$$

$$= P + 2x_u + 3 - 2y_u + 2$$

$$\therefore P_{new} = P + 2x_u - 2y_u + 5$$

Conclusion \rightarrow The midpoint circle Algorithm efficiently draws circle using integer arithmetic and symmetry, ensuring accurate and smooth result with minimal computational overhead. Its simplicity and effectiveness make it ideal for real time graphics applications.

✓ 14/18