Unit - 2

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Scan Conversion and Output Premitives

Points and Lines:- (i) Point plotting is accomplished by converting a single coordinate position furnished by an application program into appropriate operations for the output device in use.

With a CRT monitor, the electron beam is turned on to illuminate the screen phosphor at the selected location.

A random - scan (vector) system stores point - plotting instruction in the display list and coordinate values in these instructions are converted to deflection voltages that position the electron beam at the screen locations to be plotted during each refresh cycle. For a Black and White raster system a point is plotted by setting the bit value corresponding to a specified screen position within the frame buffer to 1. Then, as the electron beam sweeps across each horizontal scan line, it emits a burst of electrons (plots a point) whenever a value of 1 is encountered in the frame buffer. With an RGB system, the frame buffer is loaded with the color codes for the intensities that are to be displayed at the screen pixel positions.

(ii) **Scan converting a Line** :- Line drawing is accomplished by calculating intermediate positions along the line path between two specified endpoint positions. An output device is then directed to fill in these positions between the endpoints. For analog devices, such as a vector pen plotter or a random-scan display, a straight line can be drawn smoothly from one endpoints to the other. Linearly varying horizontal and vertical deflection voltages are generated that are proportional to the required changes in the x and y directions to produce the smooth line.

Digital Devices display a straight line segment by plotting discrete points between the two endpoints. Discrete coordinate positions along the line path are calculated from the equation of the line. For a raster video display, the line color (intensity) is then loaded into the frame buffer at the corresponding pixel coordinates. Reading from frame buffer, the video controller then "plots" the screen pixels. Screen locations are referenced with integer values so plotted positions may only approximate actual line positions between two specified endpoints. A computed line position of (10.48, 20.51) for example, would be converted to pixel position

(10, 21). This rounding of coordinate values to integers causes lines to be displayed with a stairstep appearance. The characteristic stairstep shape of raster lines is particularly noticeable on systems with low resolution, and we can improve their appearance somewhat by displaying them on high resolution system. More effective techniques for smoothing raster lines are based on adjusting pixel intensity along the line path.

Line-Drawing Algorithm

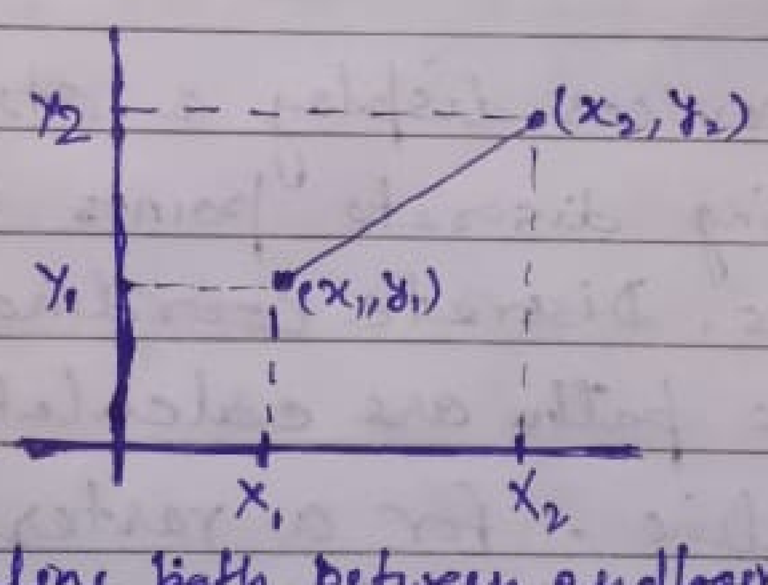

fig- line path between endpoints positions (x_1, y_1) and (x_2, y_2)

The Cartesian slope-intercept equation for a straight line is

$$y = m \cdot x + b \quad \text{——— (1)}$$

with m representing the slope of the line and b as the y intercept. Given that the two endpoints of a line segment are specified at positions (x_1, y_1) and (x_2, y_2)

as shown in above figure. We can determine values for the slope m and y intercept b with the following calculations:

$$m = \frac{y_2 - y_1}{x_2 - x_1} \quad \text{——— (2)}$$

$$b = y_1 - m \cdot x_1 \quad \text{——— (3)}$$

Algorithm for displaying straight lines are based on the line eqn (1) and the calculation given in eqn (2) and (3).

For any given x interval Δx along a line, we can compute the corresponding y interval Δy from eqn (2) as

$$\Delta y = m \Delta x \quad \text{——— (4)}$$

Similarly, we can obtain the x interval Δx corresponding to a specified Δy as

$$\Delta x = \frac{\Delta y}{m} \quad \text{——— (5)}$$

For lines with slop magnitudes $|m| < 1$, Δx can be set proportional to a small horizontal deflection voltage and the corresponding vertical deflection is then set proportional to Δy as calculated from eqn (4). For lines whose slopes have magnitude $|m| > 1$, Δy can be set proportional to a small vertical deflection voltage with the corresponding horizontal deflection voltage set proportional to Δx, calculated from eqn (5). For line with $m = 1$, $\Delta x = \Delta y$ and the horizontal and vertical deflection voltage are equal. In each case, a smooth line with slope m is generated between the specified endpoints.