Sobel Edge Detection

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1 Sobel Edge Detection

The Sobel edge detection method is a technique used to highlight edges in an image. It involves applying convolution operations using Sobel kernels to compute gradients in both the horizontal and vertical directions. These gradients are then combined to obtain the magnitude of the gradient, which represents the edge strength at each pixel.

1.1 Sobel Kernels

The Sobel kernels are defined as follows:

$$G_x = \begin{bmatrix} 1 & 0 & -1 \\ 2 & 0 & -2 \\ 1 & 0 & -1 \end{bmatrix}$$

$$G_y = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$

1.2 Gradient Calculation

Given a grayscale image I and the Sobel kernels G_x and G_y, the gradients in the x and y directions at a pixel (i, j) are calculated by convolving the kernels with a neighborhood of pixels centered at (i, j):

$$\text{Gradient}_x(i, j) = \sum_{m=-1}^{1} \sum_{n=-1}^{1} G_x(m, n) \cdot I(i + m, j + n)$$

$$\text{Gradient}_y(i, j) = \sum_{m=-1}^{1} \sum_{n=-1}^{1} G_y(m, n) \cdot I(i + m, j + n)$$

1.3 Edge Magnitude

The magnitude of the gradient at pixel (i, j) is calculated as:

$$\text{Magnitude}(i, j) = \sqrt{\text{Gradient}_x(i, j)^2 + \text{Gradient}_y(i, j)^2}$$

This magnitude represents the strength of the edge at that pixel. Higher values indicate stronger edges.

2 Results

The following figures show the steps involved in the Sobel edge detection method applied to an image.

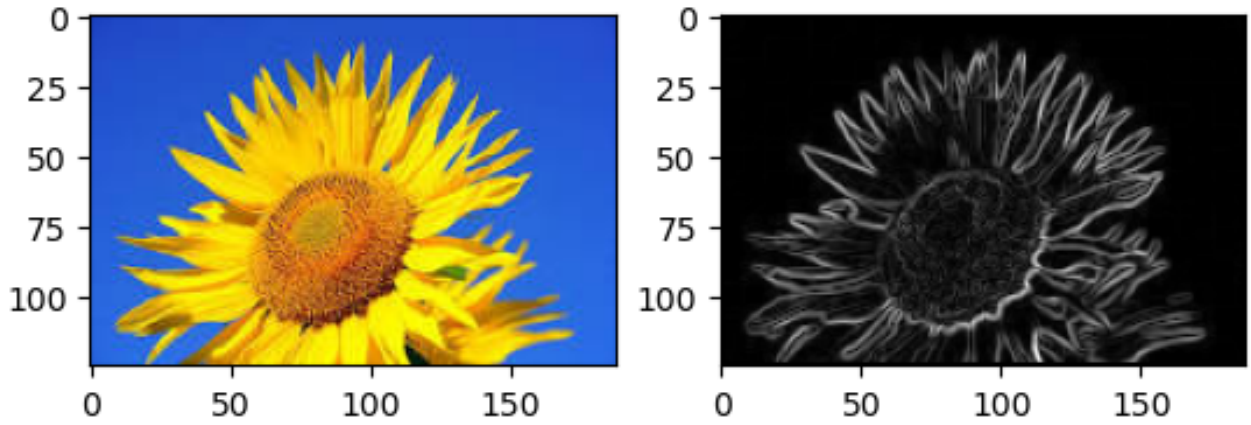

Figure 1: Edge Detection of an image