Assignment - 3: Edge Detection

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Alternative Algorithms: Sobel, Prewitt

Sobel-Feldman operator:

Since the intensity function of a digital image is only known at discrete points, derivatives of this function cannot be defined unless we assume that there is an underlying differentiable intensity function that has been sampled at the image points. With some additional assumptions, the derivative of the continuous intensity function can be computed as a function on the sampled intensity function, i.e. the digital image. It turns out that the derivatives at any particular point are functions of the intensity values at virtually all image points. However, approximations of these derivative functions can be defined at lesser or larger degrees of accuracy.

The Sobel-Feldman operator represents a rather inaccurate approximation of the image gradient, but is still of sufficient quality to be of practical use in many applications. More precisely, it uses intensity values only in a 3×3 region around each image point to approximate the corresponding image gradient, and it uses only integer values for the coefficients which weight the image intensities to produce the gradient approximation.

```
function sobel(A : as two dimensional image array)
    Gx=[-1 0 1; -2 0 2; -1 0 1]
    Gy=[-1 -2 -1; 0 0 0; 1 2 1]

    rows = size(A,1)
    columns = size(A,2)
    mag=zeros(A)

    for i=1:rows-2
        for j=1:columns-2
            S1=sum(sum(Gx.*A(i:i+2,j:j+2)))
            S2=sum(sum(Gy.*A(i:i+2,j:j+2)))

            mag(i+1,j+1)=sqrt(S1.^2+S2.^2)
        end for
    end for

    threshold = 70 %varies for application [0 255]
    output_image = max(mag,threshold)
    output_image(output_image==round(threshold))=0;
    return output_image
end function
```

Prewitt Operator:

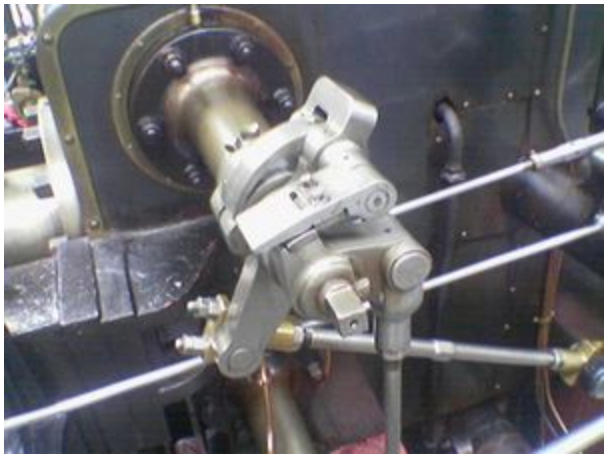
It is a discrete differentiation operator, computing an approximation of the gradient of the image intensity function. At each point in the image, the result of the Prewitt operator is either the corresponding gradient vector or the norm of this vector. The Prewitt operator is based on convolving the image with a small, separable, and integer valued filter in horizontal and vertical directions and is therefore **relatively inexpensive in terms of computations** like Sobel and Kayyali operators. On the other hand, the gradient approximation which it produces is relatively crude, in particular for high frequency variations in the image.

Prewitt Gradient Kernels:

$$\mathbf{G_x} = \begin{bmatrix} +1 & 0 & -1 \\ +1 & 0 & -1 \\ +1 & 0 & -1 \end{bmatrix} * \mathbf{A} \quad \text{and} \quad \mathbf{G_y} = \begin{bmatrix} +1 & +1 & +1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{bmatrix} * \mathbf{A}$$

where $*$ here denotes the 1-dimensional convolution operation.

Original Image



After Processing