Palawan State University
College of Sciences
Computer Studies Department

DIGITAL IMAGE PROCESSING LABORATORY EXERCISE #9

Implementation of image sharpening filters and Edge Detection using Gradient Filters

These techniques are fundamental in various image processing applications, including image enhancement, feature extraction, and object detection.

1. **Image Sharpening Filters:**
    - Image sharpening filters aim to enhance image details and improve visual clarity by increasing the contrast along edges and transitions in pixel intensity.
    - Common sharpening filters include the Laplacian filter, the Unsharp Masking (USM) filter, and the High Boost filter.
    - The Laplacian filter detects regions of rapid intensity change in the image by computing the second derivative of the image intensity function.
    - Unsharp Masking enhances edges by subtracting a blurred version of the image from the original, emphasizing high-frequency components.
    - The High Boost filter is a variation of Unsharp Masking that allows for adjustable sharpening strength.

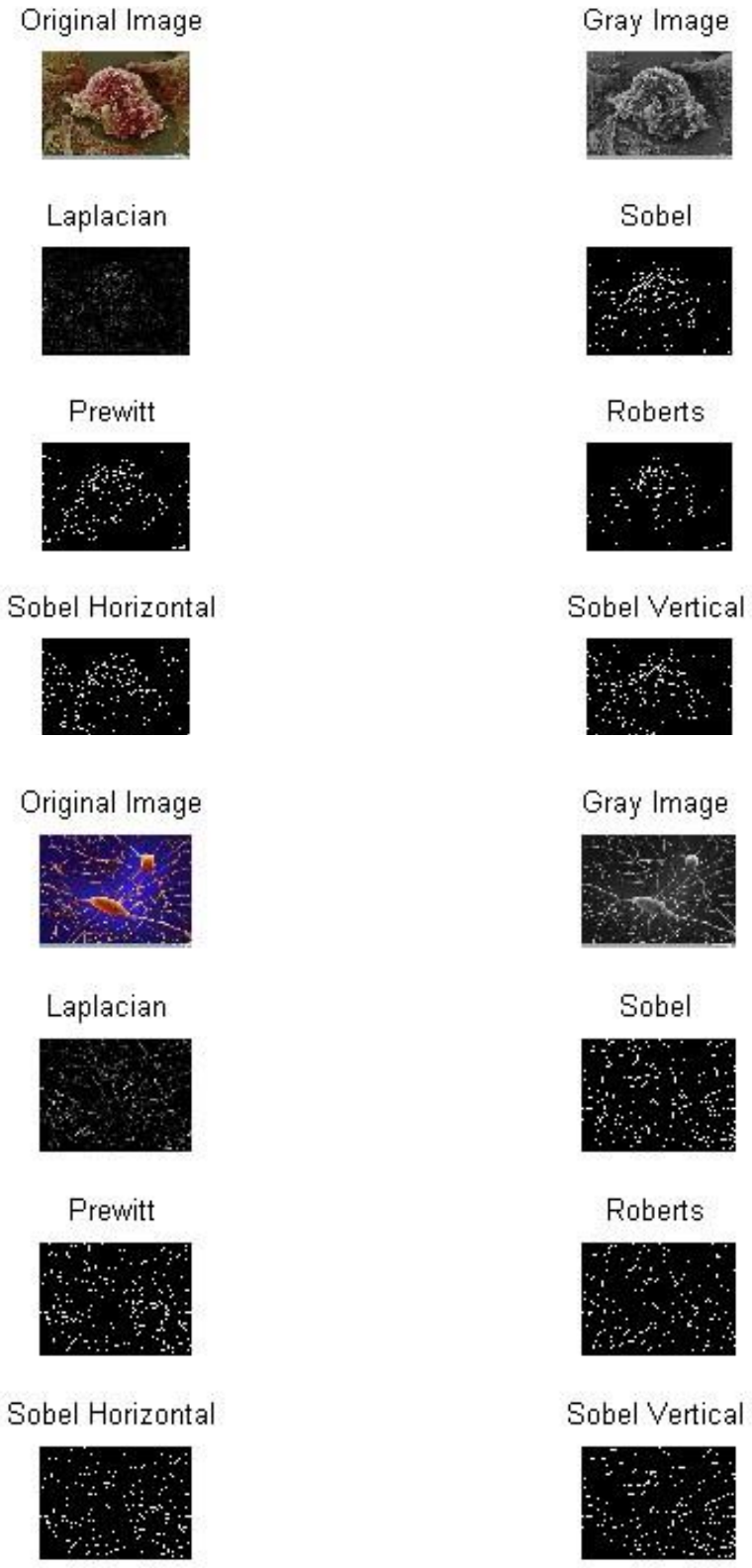
2. **Edge Detection using Gradient Filters:**
    - Edge detection is the process of identifying points in an image where the brightness significantly changes, indicating the presence of an edge or boundary.
    - Gradient-based edge detection methods use derivatives of the image intensity function to locate areas of rapid change.
    - Common gradient filters include the Sobel, Prewitt, and Robert's operators, which compute the gradient magnitude and direction at each pixel.
    - The gradient magnitude represents the strength of the edge, while the gradient direction indicates the orientation of the edge.

The steps for implementing image sharpening filters and edge detection using gradient filters typically involve the following:

1. Convolution: Apply the chosen filter kernel to the image using convolution to compute the response at each pixel.
2. Thresholding: Threshold the response to enhance edges or sharpen the image.
3. Post-processing: Optional steps such as non-maximum suppression for thinning edges or adjusting sharpening strength may be applied.

```
i=imread('cancercell.jpg'); subplot(4,2,1); imshow(i); title('Original Image');
g=rgb2gray(i);
subplot(4,2,2); imshow(g); title('Gray Image');
f=fspecial('laplacian',0.05); im=imfilter(g,f);
subplot(4,2,3); imshow(im); title('Laplacian ');
s=edge(g, 'sobel');
subplot(4,2,4); imshow(s); title('Sobel');
p=edge(g, 'prewitt');
subplot(4,2,5); imshow(p); title('Prewitt');
r=edge(g, 'roberts');
```

```
subplot(4,2,6); imshow(r); title('Roberts');
[BW,thresh,gv,gh]=edge(g,'sobel',[],'horizontal');
[BW1,thresh1,gv1,gh1]=edge(g,'sobel',[],'vertical');
subplot(4,2,7); imshow(BW); title('Sobel Horizontal'); subplot(4,2,8);
imshow(BW); title('Sobel Vertical');
```



Exercise #9

Implementation of image sharpening filters and Edge Detection using Gradient Filters

Name:
Year/Block:
Application/Software:

1. Codes
2. Output
3. Answer the following questions:

   A. How do image sharpening filters contribute to enhancing image details and improving visual clarity? Can you explain the differences between common sharpening filters such as the Laplacian filter, Unsharp Masking (USM) filter, and High Boost filter, and discuss their respective implementation processes?

   B. What is edge detection, and how do gradient filters play a role in identifying edges within images? Can you describe popular gradient-based edge detection methods such as the Sobel, Prewitt, and Robert's operators, and explain how they compute edge strength and orientation?

   C. In practical applications, how are image sharpening filters and edge detection techniques using gradient filters utilized? Can you provide examples of real-world scenarios where these techniques are employed, and discuss their importance in tasks such as image enhancement, feature extraction, and object detection?