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Assignment 6 (**Image processing assignment)**

Using Sobel Filter for Edge Detection

Project for Intelligent Systems for Pattern Recognition

Set up environment

- Use OpenCV and Numpy

```
import numpy as np
import cv2 as cv
```

- Take Image

```
cv.cvtColor(cv.imread(path,cv.COLOR_BGR2GRAY)
```

- Construct Sobel Filter
  - Direction X
  - Direction Y

```
sobelX = np.array((
    [+1, 0, -1],
    [+2, 0, -2],
    [+1, 0, -1]), dtype="int")
```

```
sobelY = np.array((
    [+1, +2, +1],
    [0, 0, 0],
    [-1, -2, -1]), dtype="int")
```

Apply Sobel Filter

- Convolution Function
  - Replicate Border

    ```
    cv.copyMakeBorder(params, cv.BORDER_REPLICATE)
    ```

  - Take Region of Interest

    ```
    roi = image[y - pad:y + pad + 1, x - pad:x + pad + 1]
    ```

  - Compute the convolution

    ```
    for i in range(kH):
        for j in range(kW):
            D[i][j] = np.dot(roi[i][j],kernel[i][j])
    ```

  - Sum over the pixel

    ```
    output[y - pad, x - pad] = D.sum()
    ```

  - Rescale output

    ```
    output = rescale_intensity(output, in_range=(0, 255))
    output = (output * 255).astype("uint8")
    ```

- Take results
  - Compute Magnitude

    ```
    magnitude = np.hypot(intensityX, intensityY)
    ```

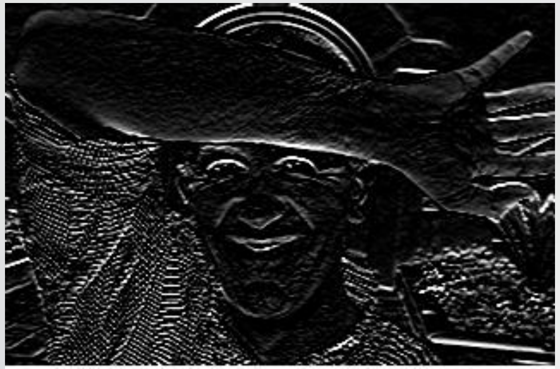
  - Take initial gradient

    ```
    np.hypot(convolutionOperation(gray, sobelX*(1/8)),
    convolutionOperation(gray, sobelY*(1/8)))
    ```

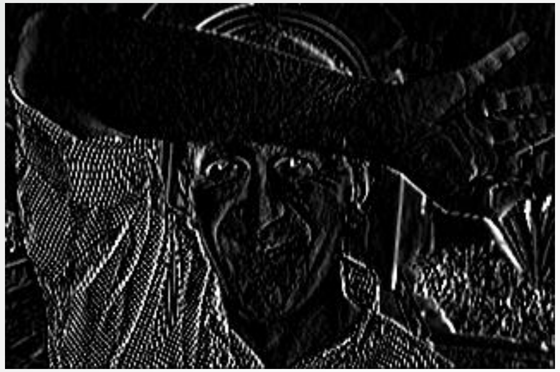
  - Take gradient direction

    ```
    np.arctan(np.divide(intensityY,intensityX))
    ```

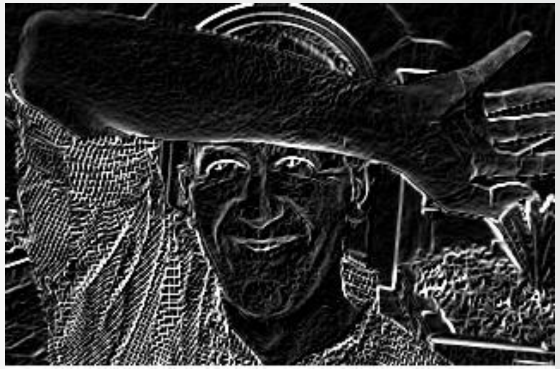
Results



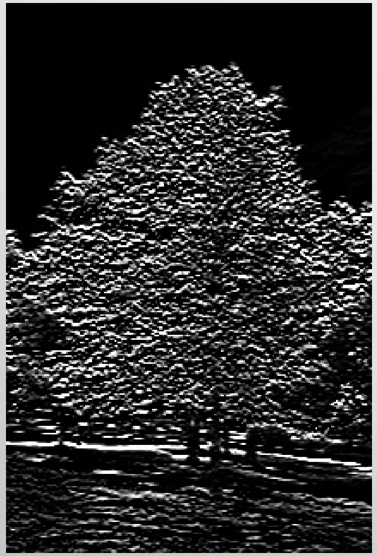
Gradient X direction

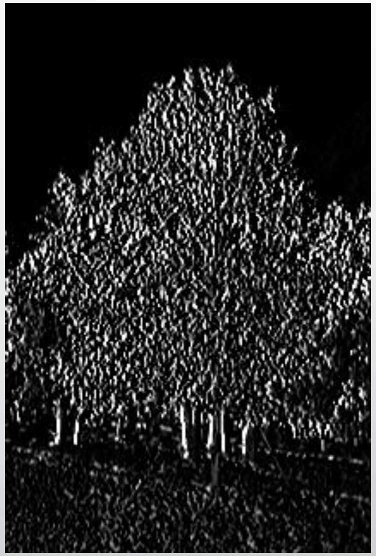


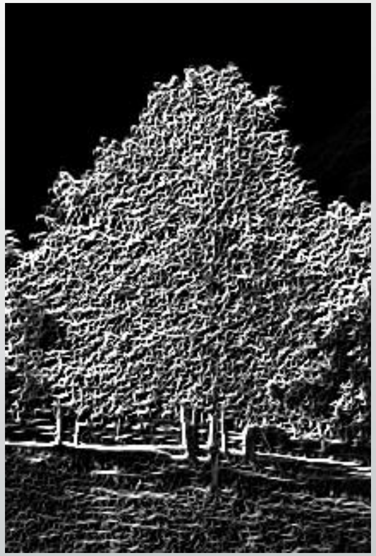
Gradient Y direction



Magnitude





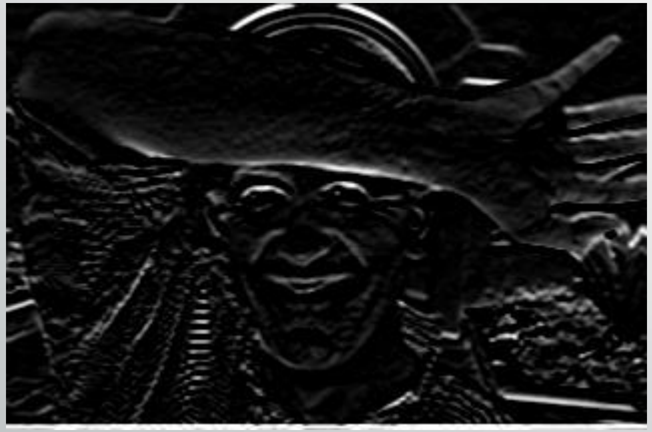


Not only: By using *phase* of OpenCV, you can get the direction (angleInDegrees=true) of the gradient; finally you can map it as colors.. Use the code to try it!

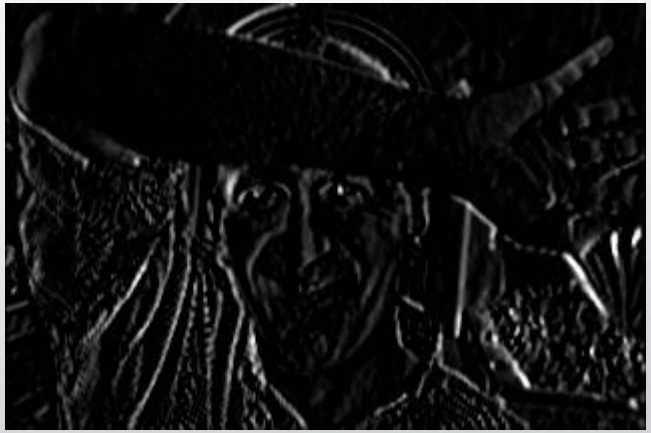
Blur Image

- Reuse the same function
- Better result applying a filter

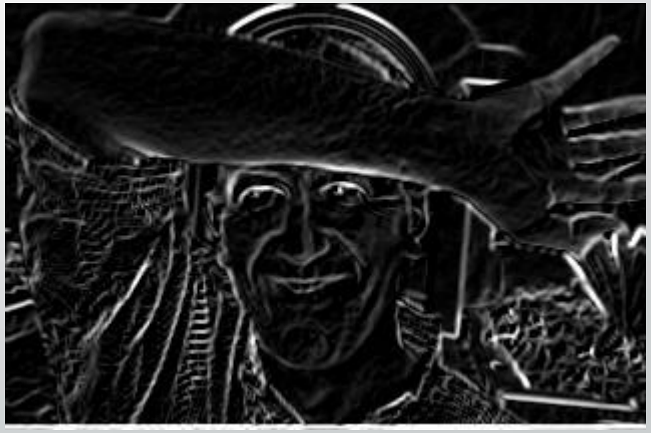
```
blur = np.ones((3, 3), dtype="float") * (1.0 /
(3 * 3))
```



Gradient X direction



Gradient Y direction



Magnitude