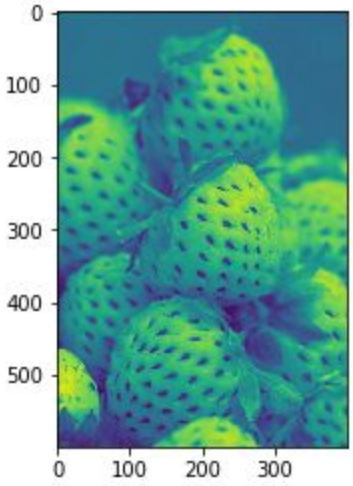
CSE 344: Computer Vision

Homework 5 ; Arka Sarkar 2018222

LBP : Local Binary Pattern

```
image = cv2.imread('straw.png')
image = cv2.cvtColor(image, cv2.CC
print(image.shape)
plt.imshow(image)
plt.show()
```

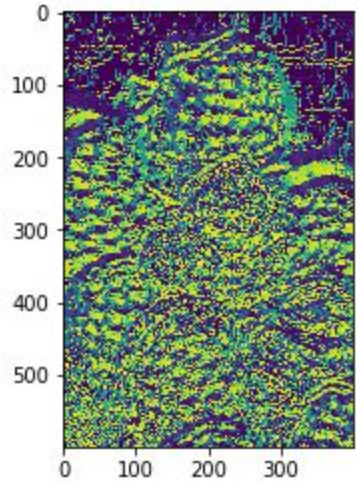
```
(600, 400)
```



Input

```
print("Image-Level LBP Feature")
plt.imshow(result)
plt.show()
```

```
Image-Level LBP Feature
```



LBP

HOG : Histogram of Gradients

1. We compute the gradient's magnitude and direction.
2. Key angles are chosen (say 0,45,90,135,180,-135,-90,-45) to form bins for the histogram.
3. For a pixel in a patch (16x16), based on the proximity of the gradient's direction with the two key angles between which the direction lies, its magnitude is shared by the bins of the two angles.
4. When we share magnitudes of each pixel in the patch this way and accumulate these magnitudes for the bins, the result is called HOG feature.

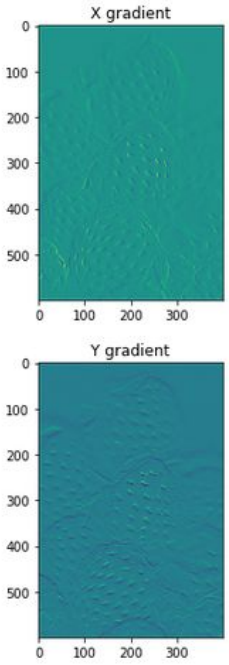
Algorithm

```
def get_gradients(image):
    sobel_x = np.array([[-1,0,1],[-2,0,2],[-1,0,1]])
    sobel_y = np.array([[-1,-2,-1],[0,0,0],[1,2,1]])

    G_x = signal.convolve2d(image,sobel_x, "same")
    G_y = signal.convolve2d(image,sobel_y, "same")

    mag = (G_x**2 + G_y**2)**0.5
    theta = np.zeros((image.shape[0], image.shape[1]))

    for i in range(image.shape[0]):
        for j in range(image.shape[1]):
            x = G_x[i,j]
            y = G_y[i,j]

            if(x > 0):
                theta[i,j] = math.degrees(math.atan(y/x))
            elif(x < 0 and y >= 0):
                theta[i,j] = math.degrees(math.atan(y/x)) + 180
            elif(x < 0 and y < 0 ):
                theta[i,j] = math.degrees(math.atan(y/x)) - 180
            elif(x == 0 and y > 0 ):
                theta[i,j] = 90
            elif(x == 0 and y < 0):
                theta[i,j] = -90
            elif(x == 0 and y == 0):
                theta[i,j] = float('NaN')
            else:
                continue
    plt.imshow(G_x)
    plt.title("X gradient")
    plt.show()
    plt.imshow(G_y)
    plt.title("Y gradient")
    plt.show()
    return mag, theta
```

```
def HOG_cell_histogram(cell_direction, cell_magnitude, hist_bins):
    HOG_cell_hist = np.zeros(shape=(hist_bins.size))
    cell_size = cell_direction.shape[0]
    bins_gaps = abs(hist_bins[0] - hist_bins[1])

    for row_idx in range(cell_size):
        for col_idx in range(cell_size):
            curr_direction = cell_direction[row_idx, col_idx]
            curr_magnitude = cell_magnitude[row_idx, col_idx]

            diff = np.abs(curr_direction - hist_bins)
#             print(diff, np.where(diff == np.min(diff)))
            try :
                min_idx = np.where(diff == np.min(diff))[0][0]

                if(min_idx == 0):
                    HOG_cell_hist[min_idx] += curr_magnitude

                elif(min_idx == hist_bins.size-1):
                    HOG_cell_hist[min_idx] += (abs(curr_direction - hist_bins[-1])/bins_gaps)*curr_magnitude
                    HOG_cell_hist[min_idx-1] += (abs(curr_direction - hist_bins[-2])/bins_gaps)*curr_magnitude
                else:
                    HOG_cell_hist[min_idx] += (abs(curr_direction - hist_bins[min_idx])/bins_gaps)*curr_magnitude
                    HOG_cell_hist[min_idx+1] += (abs(curr_direction - hist_bins[min_idx + 1])/bins_gaps)*curr_magnitude
            except:
                continue

    return HOG_cell_hist
```

```
def generate_HOG(mag, theta, image, patch_size = 8, plot = False):

    m,n = image.shape

    bins = np.array([-135, -90,-45, 0, 45, 90, 135, 180])
    HOG_hist = np.array([])

    for i in range(0,m, patch_size):
        for j in range(0,n, patch_size):

            curr_mag = mag[i : i+patch_size,j : j+patch_size]
            curr_direc = theta[i : i+patch_size,j : j+patch_size]
            bins = np.array([-135, -90,-45, 0, 45, 90, 135, 180])
            hist = HOG_cell_histogram(curr_direc, curr_mag, bins)
            if(plot):
                fig = plt.figure(figsize = (2,2))
                ax = fig.add_axes([0,0,1,1])
                x_axis = ["-135", "-90","-45", "0", "45", "90", "135", "180"]
                ax.bar(x_axis,hist)
                plt.show()
            HOG_hist = np.concatenate((HOG_hist,hist))

    return HOG_hist
```

]:
```
mag, theta = get_gradients(image)
```



]:
```
HOG_hist = generate_HOG(mag,theta, image, patch_size=16)
```

]:
```
HOG_hist.shape
```

]: (7600,)

]:
```
print("The HOG vector is :", HOG_hist)
```

```
The HOG vector is : [1170.88083216   76.70259594 5150.16228173 ... 1970.47781957 4061.18721492
  125.65309291]
```