Instruction

The Histogram of Oriented Gradients (HOG) is a feature descriptor used in computer vision and image processing applications for the purpose of the object detection. It is a technique that counts events of gradient orientation in a specific portion of an image or region of interest (see also lecture notes).

Here are the most important aspects of HOG:

- HOG focuses on the structure of the object. It extracts the information of the edge-magnitude as well as the orientation of the edges.
- It uses a detection window of 64x128 pixels, so the image is first converted into, for example, (64, 128) shape.
- The image is then further divided into small parts, and then the gradient and orientation of each part is calculated. It is divided into 8x16 cells into blocks with 50% overlap, so there are going to be 7x15 = 105 blocks in total, and each block consists of 2x2 cells with 8x8 pixels.
- We take the 64 gradient vectors of each block (8x8 pixel cell) and put them into a 9-bin histogram.

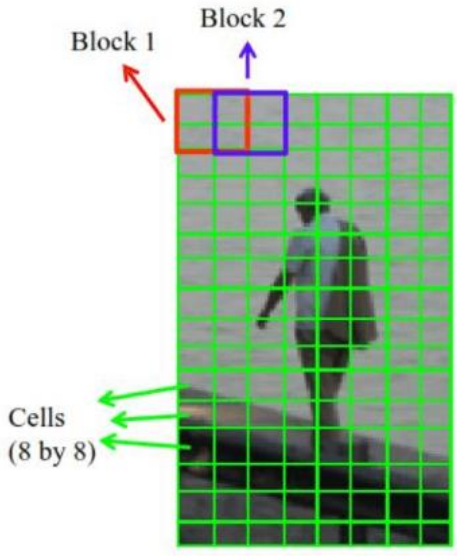

Figure 1 an example of HOG feature descriptor

The HOG feature descriptor counts the occurrences of gradient orientation in localized portions of an image.

Implementing HOG using tools like OpenCV is extremely simple. It's just a few lines of code since we have a predefined function called hog in the skimage.feature library. Our focus in this instruction, however, is on how these features are actually calculated.

Python Code

Let's start with importing the required modules:

```
from skimage.io import imread

from skimage.feature import hog

import matplotlib.pyplot as plt
```

Load the image with the help of the skimage imread() method

```
#load image

tesla_image = imread("tesla.jpg")

plt.imshow(tesla_image)

plt.show()
```

Example

Perform the HOG feature extraction on the loaded image, i.e., `tesla_image` with the help of the `hog(image, orientations, pizels_per_cell, cells_per_block, visualize, multichannel)`method.

```
#hog extraction

_, hog_image = hog(tesla_image, orientations=8, pixels_per_cell=(16, 16),

cells_per_block=(1, 1), visualize=True, multichannel=True)
```

The hog() method accepts the following six arguments:

1. **`image`** – Represents the image on which we want to perform the hog extraction.
2. **`orientations`** – Defines the number of bins in the histogram.
3. **`pixels_per_cell`** – Defines the number of grids per patch.
4. **`cells_per_block`** – It is the number of cells for every block.
5. **`visualize`** – A Boolean value that specifies whether to return the image of HOG or not.
6. **`multichannel`** It is a Boolean value. True sets the last dimension to the color channel rather than spatial.

Lastly, show the hog image with the `plt.imshow()` method.

```
#show image

plt.imshow(hog_image)

plt.show()
```

Result

The output would be: