Vidyavardhini's College of Engineering & Technology

Department of Computer Engineering

To study Detecting and Recognizing Objects
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Aim: To study Detecting and Recognizing Objects

Objective: Object Detection and recognition techniques HOG descriptor. The scale issues the location issue non maximum (or non maxima) suppression vector machine people detection.

Theory:

Histogram of Oriented Gradients (HOG) is a popular feature extraction technique used for object detection and recognition in computer vision and image processing. It's particularly effective in detecting objects with distinct texture and shape patterns. Here's an overview of how HOG descriptor works for object detection and recognition:

- Image Preprocessing:

Convert the input image to grayscale if it's a color image, as HOG is typically applied to grayscale images.

Optionally, you can perform some basic preprocessing like histogram equalization to improve contrast.

- Image Gradient Calculation:

Compute the gradient of the image to capture local intensity variations. The gradient is calculated using techniques like Sobel, Scharr, or Prewitt operators.

- Cell Division:

Divide the image into small cells (e.g., 8x8 or 16x16 pixels). These cells are used to calculate histograms of gradients within their regions.

- Gradient Histograms:

Calculate gradient magnitudes and orientations within each cell. Typically, the gradient magnitude is computed as the square root of the sum of squared gradients in both directions, and the orientation is determined using the arctangent function.

Quantize gradient orientations into bins (e.g., 9 bins covering 0-180 degrees). Each gradient contributes to the corresponding bin based on its orientation.

- Block Formation:

Group cells into larger blocks (e.g., 2x2 or 3x3 cell blocks). Blocks are overlapping or non-overlapping regions that help capture spatial relationships between gradients.

- HOG Descriptor Calculation:

Within each block, concatenate the histograms of gradient orientations from the constituent cells.

Optionally, normalize the block's concatenated histogram to make the descriptor more robust to changes in lighting and contrast. Common normalization methods include L1-Norm or L2-Norm.

- Sliding Window and Detection:

Slide a detection window (often called a "sliding window") over the entire image at different scales. At each position and scale, compute the HOG descriptor for the window content.

These HOG descriptors can be compared to pre-trained HOG descriptors of the object you want to detect or recognize using machine learning techniques like Support Vector Machines (SVM) or Convolutional Neural Networks (CNNs).

- Object Detection and Recognition:

Apply a classifier (e.g., SVM) trained on positive and negative examples to the HOG descriptors extracted from the sliding window. The classifier will provide a confidence score or label indicating the presence or absence of the object.

Optionally, use non-maximum suppression to eliminate duplicate or closely overlapping detections.

Code:-

```
from skimage.io import imread

from skimage.transform import resize

from skimage.feature import hog

from skimage import exposure

import matplotlib.pyplot as plt


# reading the image


img = imread('/content/MB.jpg')

plt.axis("off")

plt.imshow(img)

print(img.shape)
```

```
# resizing the image

resized_img = resize(img, (128*4, 64*4))

plt.axis("off")

plt.imshow(resized_img)

print(resized_img.shape)
```

```
#creating hog features


fd, hog_image = hog(resized_img, orientations=9, pixels_per_cell=(8, 8),
                                    cells_per_block=(2,  2),  visualize=True,
multichannel=True)

plt.axis("off")

plt.imshow(hog_image, cmap="gray")
```

Output:-

Conclusion:

In conclusion, the aim of studying the detection and recognition of faces was successfully accomplished. Through this study, we explored various methods and technologies for accurately detecting and recognizing faces within images. Our findings demonstrate the importance of this research in applications for detecting objects like pedestrians, faces, and vehicles in images, especially when combined with a machine learning classifier. However, for more complex and diverse object recognition tasks, deep learning approaches like CNNs have become the norm due to their ability to automatically learn hierarchical features.