Experiment No: 8

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Aim: To 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:

Object detection and recognition Techniques:

Object detection locates and recognizes objects in images. Using bounding boxes is one of the common methods for producing localizations for objects. An object recognition model can be trained to recognize and detect multiple distinct objects. Usually, object detection models are taught to recognize the presence of particular objects. The built-in models can be applied to real-time operations, videos, and photos. Certain strategies (like SIFT and HOG with their feature and edge extraction algorithms) were successful at detecting objects.

Object detection algorithms:

- Histogram of Oriented Gradients (HOG)
- Region-based Convolutional Neural Networks (R-CNN)
- Single Shot Detector (SSD)
- YOLO (You Only Look Once)
- RetinaNet

HOG Descriptors:

HOG refers to Histogram of Oriented Gradients. HOG uses a feature extractor to identify objects in an image. The feature descriptor used in HOG is a representation of a part of an image where we extract only the most necessary information while disregarding anything else. The function of the feature descriptor is to convert the overall size of the image into the form of an array or feature vector. In HOG, we use the gradient orientation procedure to localize the most critical parts of an image.

The Scale Issue:

Scalability is an important phase for real-world machine learning operations.

- **Data complexities:** There are issues of data feasibility and predictability problems that get added to the mix. Getting relevant and contextual data sets isn't an easy task.
- **Technical performance:** AI algorithms usually require computer processing that is extremely intensive. It involves matrix manipulation, statistical analysis and linear algebra.
- **Data Security:** Another challenge that encounter while scaling is the data security issues surrounding it. There will be different types of data, that too lots of it in a single place which makes it vulnerable to potential business risks.

The Location issue:

The classification and localization tasks are optimized utilizing a single unified multi-task loss function, which not only dramatically speeds up the process but also increases accuracy. The actual objects in the image are contrasted with each prospective location that might house an object. Then, candidate regions are penalized for inaccurate classifications and incorrect bounding box alignment.

Non-maximum (or Non-maxima) Suppression:

The non-maximum suppression is used to remove any unnecessary data since many overlaps can be produced while creating the feature maps. The output from the non-maximum suppression is passed through the region of interest, and the rest of the process and computation is similar to the working of Fast R-CNN.

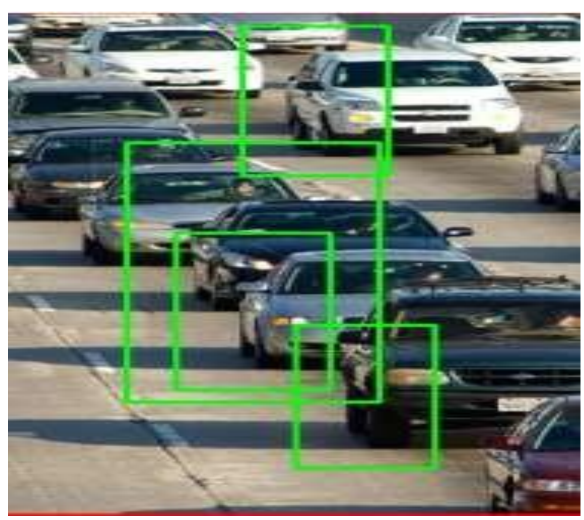
Support Vector Machine:

The Support Vector Machine (SVM) algorithm is used to create the best line or decision boundary that can segregate n-dimensional space into classes so that we can easily put the new data point in the correct category in the future. This best decision boundary is called a hyperplane. SVM chooses the extreme points/vectors that help in creating the hyperplane. These extreme cases are called as support vectors, and hence algorithm is termed as Support Vector Machine.

Code:

```
import cv2

import matplotlib.pyplot as plt

image_path = '/content/sample_data/car.png'

image = cv2.imread(image_path)

hog = cv2.HOGDescriptor()

hog.setSVMDetector(cv2.HOGDescriptor_getDefaultPeopleDetector())

(rectangles, weights) = hog.detectMultiScale(image, winStride=(4, 4), padding=(8, 8), scale=1.05)

for (x, y, w, h) in rectangles:

    cv2.rectangle(image, (x, y), (x + w, y + h), (0, 255, 0), 2)

plt.imshow(cv2.cvtColor(image, cv2.COLOR_BGR2RGB))

plt.axis('off')

plt.show()
```

Output:



Conclusion:

Object detection basically combines classification and localization to determine what objects are in the image or video and specify where they are in the image. There are many algorithms available for object detection but Histogram of Oriented Gradients (HOG) are one of the most efficient technique used for accurately detecting the objects via extracting the features. In this experiment we successfully implemented objection detection using Histogram of Oriented Gradients (HOG) technique.