Pooja Naskar - 30

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 helps find and identify things in pictures. One typical way to produce localizations for objects is to use bounding boxes. Multiple unique items can be detected and recognized by an object recognition model that has been trained. Typically, object identification models are trained to identify certain items. Photos, videos, and real-time operations can all be used with the built-in models. Using their feature and edge extraction techniques, SIFT and HOG, among other strategies, were effective in identifying 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:

Histogram of Oriented Gradients is referred to as HOG. A feature extractor is used by HOG to locate items in a picture. The feature descriptor that HOG uses is a depiction of an area of an image from which we extract only the information that is absolutely required, discarding everything else. The purpose of the feature descriptor is to transform the image's overall size into an array or feature vector. To locate an image's most important areas, HOG employs the gradient orientation process.

The Scale Issue:

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

- Data complexities: Predictability issues and data feasibility concerns are added to the mix. Obtaining contextual and relevant data sets is a difficult task.
- Technical performance: Artificial intelligence algorithms often necessitate highly intense computer processing. It includes linear algebra, statistical analysis, and matrix manipulation.
- Data Security: The challenges related to data security arise during the scaling process. There will be a variety of data kinds, and a large amount of them in one location, which leaves it open to possible business risks.

The Location issue:

Using a single unified multi-task loss function, the classification and localization tasks are optimized, leading to significant speedups and accuracy gains. Each potential location where an object might be housed is compared with the actual things in the image. Next, erroneous bounding box alignment and classifications are punished for candidate regions.

Non-maximum (or Non-maxima) Suppression:

When making feature maps, a lot of overlaps may occur, hence non-maximum suppression is employed to eliminate any extraneous data. After the non-maximum suppression output is sent through the region of interest, the remaining steps and calculations resemble how Fast R-CNN operates.

Support Vector Machine:

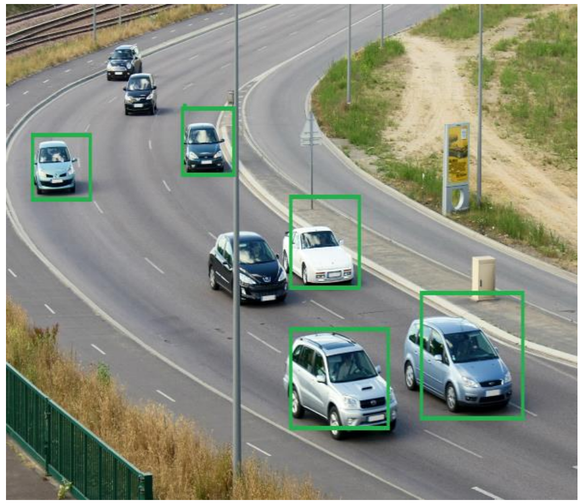
To effortlessly place a new data point in the appropriate category in the future, the optimal line or decision boundary that can divide n-dimensional space into classes is created using the Support Vector Machine (SVM) algorithm. We refer to this optimal decision boundary as a hyperplane. SVM selects the extreme vectors and points to aid in the creation of the hyperplane.

The algorithm is referred regarded as a Support Vector Machine since these extreme situations are known as support vectors.

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.