Car and Pedestrians Detection

ay6582@rit.edu
Ashwin Yogesh

Algorithm Used: Haar Cascade Object Detection

Discussion:

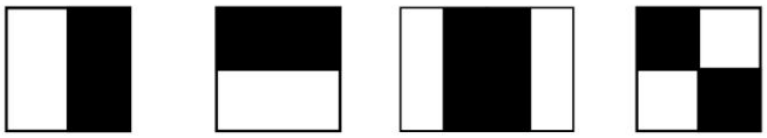
- The object detection method was proposed by Paul Viola and Micheal Jones in the paper titled "**Rapid Object Detection using a Boosted Cascade of Simple Features**".

- The function is trained over positive and negative images. This trained model is used to detect objects in other frames.

Car = Yes

Car = No

- Features are extracted from positive images and negative images. Haar features are similar to the Convolution kernel. The feature value is obtained by subtracting the sum of pixels under white region from the sum of pixels under black region.

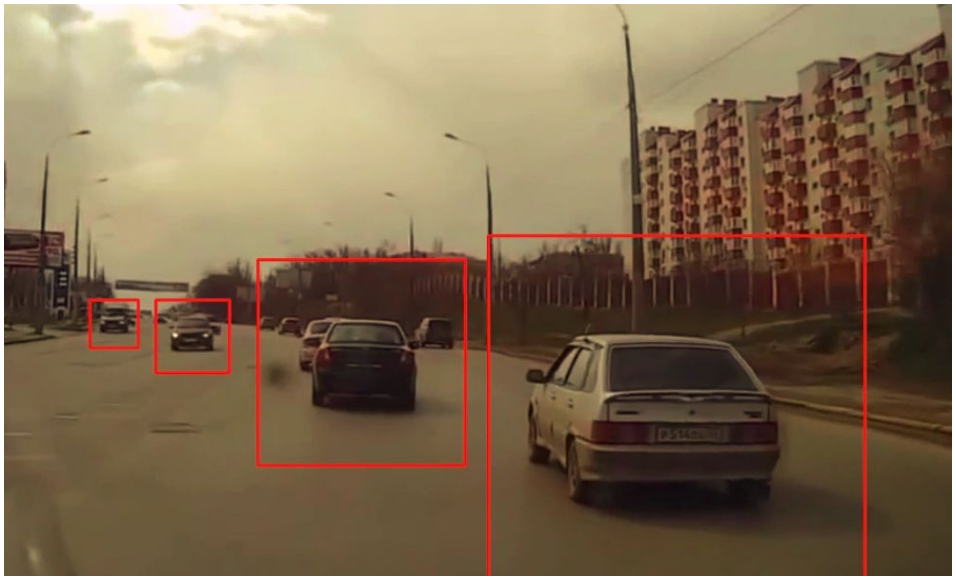


- The above image shows Haar features. 1 & 2 indicate edge features. 3 indicates a line feature and 4 indicates rectangle feature.

- Adaboost technique is used to select relevant features and discard the other features. A threshold is calculated for each feature. Finally features with lowest error rate and considered for classification. The final classifier obtained is a weighted sum of the weak classifiers.

- This process is time consuming and requires a lot of CPU usage. Therefore, the authors have used the concept of cascade of Classifiers. Apply few selected features, only if they provide good results proceed to apply further features.

Results: The first frame shows bad detection. The second frame shows good detection of cars.



- **Pedestrians -** The first two frames show good pedestrian detection. The last frame shows a bad pedestrian detection.


Impressions:

- This classifier suffers from a lot of false positives. A slight improvement to avoid false positives is to set the bounding boxes between two thresholds. This makes sure the bounding boxes below a certain value are not detected. The downside of this approach is that it fails to be invariant of the size of the car appearing in frames.
- Having a larger dataset with a large feature set is also a way to improve efficiency of the algorithm.
- I have used a pretrained model with features and threshold in cars.xml and peds.xml. Training a model from scratch and selecting features manually will also help improve efficiency.

Learning:

- I learnt about various machine learning approaches for object detection such as Region-based Convolutional networks, You Only Look Once etc
- Haar Object detection is similar to CNN but computationally less expensive and has faster processing speed.
- The process uses a special representation called “integral image” which allows quicker computation. Use of adaboost yields efficient classifiers. Cascading of these classifies allows the background region to be discarded and focus on objects only.
- Visualization of results using our dataset helped me understand the rate of false positives and learn about ways to limit the false positives.

References:

1. https://www.geeksforgeeks.org/python-haar-cascades-for-object-detection/
2. https://towardsdatascience.com/computer-vision-detecting-objects-using-haar-cascade-classifier-4585472829a9
3. https://github.com/AdityaPai2398/Vehicle-And-Pedestrian-Detection-Using-Haar-Cascades