HomeWork-3: Parking Lot Vacancy Detector

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The assignment aims at implementation of an automated solution to convey information about the number of available parking space at a parking lot ,by displaying the number of available parking spaces at the entrance to the parking lot.

Cascade Classifier Training:

1.Training set

In this step I used the Sunny scenario in each parking lot set to create my own training set, for this step used the ElementTree xml parser API, the xml file was inspected to parse the values corresponding to the 'occupied' variable , if it is 1 which means car is present, the image was cropped and classified as positive dataset , if the Occupied variable is 0 then the car is not present and classified as negative dataset, 165,121 images were classified under Positive dataset And 180,161 images as negative dataset.
Below is the example of positive data set

The Negative dataset is as follows

The python Program for the above operation "CvAssignment3xml.py" is attached with the report.

2. Train your cascade classifier

Training the cascade classifier is the next step, I used opencv_tariningcascade utility for this operation.

Number of positive samples used – 20,000 images

Number of negative samples used – 10,000 images

Number of stages – 10

Width and height of image – 20, 20 , I chose 20,20 to reduce the amount of time in training and to avoid running out of memory , since my laptop is not very powerful going for big images would have crashed my system , so had to reduce the width and height.

below is the command used for training the cascade for HAAR like features

opencv_traincascade -data data -vec positives.vec -bg bg.txt -numPos 20000 -numNeg 10000 -numStages 10 -w 20 -h 20

training took a lot of time to produce the cascade.xml .

the output of this training is in the file “output_HAAR.doc”

The command for cascade training for LBP - Local binary patterns is as below ,

C:\Users\lavan\Desktop\cv_assignment>opencv_traincascade -data data -vec positives.vec -bg bg.txt -numPos 1800 -numNeg 900 -numStages 10 -w 20 -h 20 -featureType LBP

We have to specify the featureType as LBP , default is HAAR.

The output of LBP training is in the file “output_LBP.Doc”

At the end of the training we obtain cascade.xml file and stagewise report of the training.

Performance - The HAAR classifier worked better when compared to LBP classifier, the number of cars detected in HAAR Correctly is more compared to LBP.

The time taken by HAAR is more compared to Time taken by LBP training.

N-current feature for this cascade

HR is the hit rate – percentage of positive samples that are classified as such

FA is False alarm – percentage of negative samples incorrectly classified as positive

More the HR value for a classifier more is the accuracy of the classifier , below is the table comparing the HR and FA values of both HAAR and LBP

| No of stages | HAAR Classifier | | LBP classifier | |
|---|---|---|---|---|
| | HR | FA | HR | FA |
| 0 | 0.9971 | 0.2503 | 0.9986 | 0.3098 |
| 1 | 0.996 | 0.4847 | 0.9985 | 0.5311 |
| 2 | 0.99585 | 0.3963 | 0.9962 | 0.2486 |
| 3 | 0.996 | 0.3418 | 0.99695 | 0.4749 |
| 4 | 0.99625 | 0.4564 | 0.99565 | 0.3274 |
| 5 | 0.9958 | 0.327 | 0.9951 | 0.3637 |
| 6 | 0.99515 | 0.408 | 0.99535 | 0.4228 |
| 7 | 0.99595 | 0.4428 | 0.9954 | 0.3799 |
| 8 | 0.99515 | 0.3287 | 0.99525 | 0.4226 |

As we can see from the above table the Hit rate for HAAR classifier is always more than 0.995 or 99.5% and False alarm is always less than 0.48 or 48% . which is better than LBP

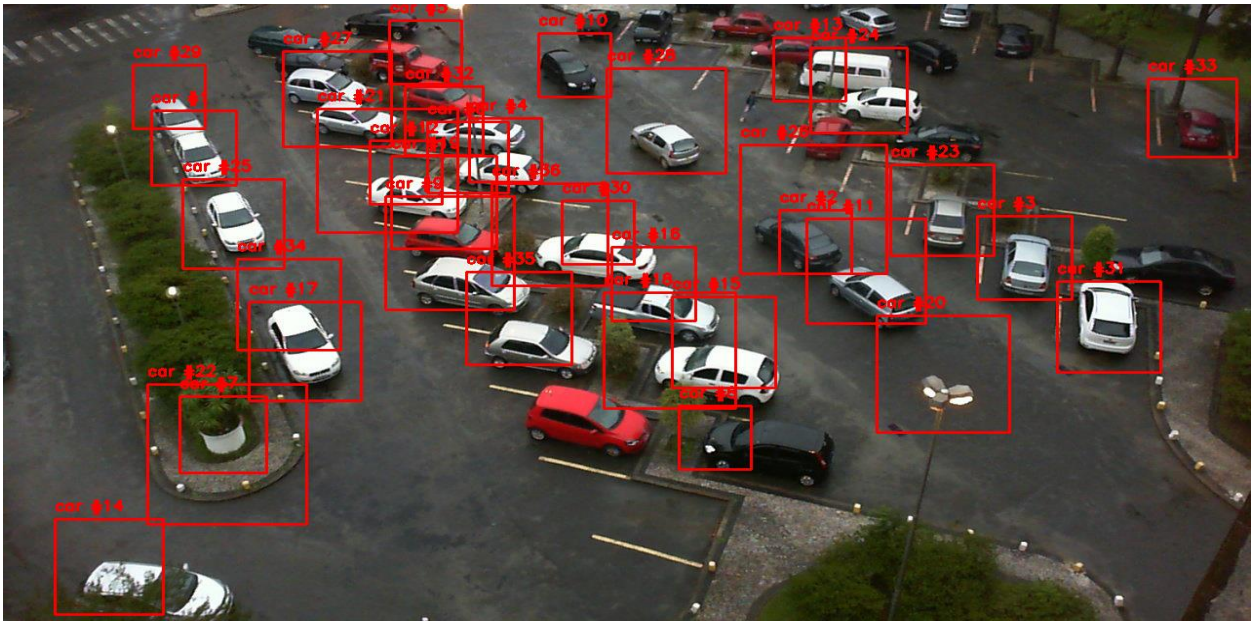
In LBP the HR is always more than 0.995 but the False alarm is some times around 0.53 which is more compared to HAAR , which indicates there might be more false Detection of images in LBP.

3. Car Detection

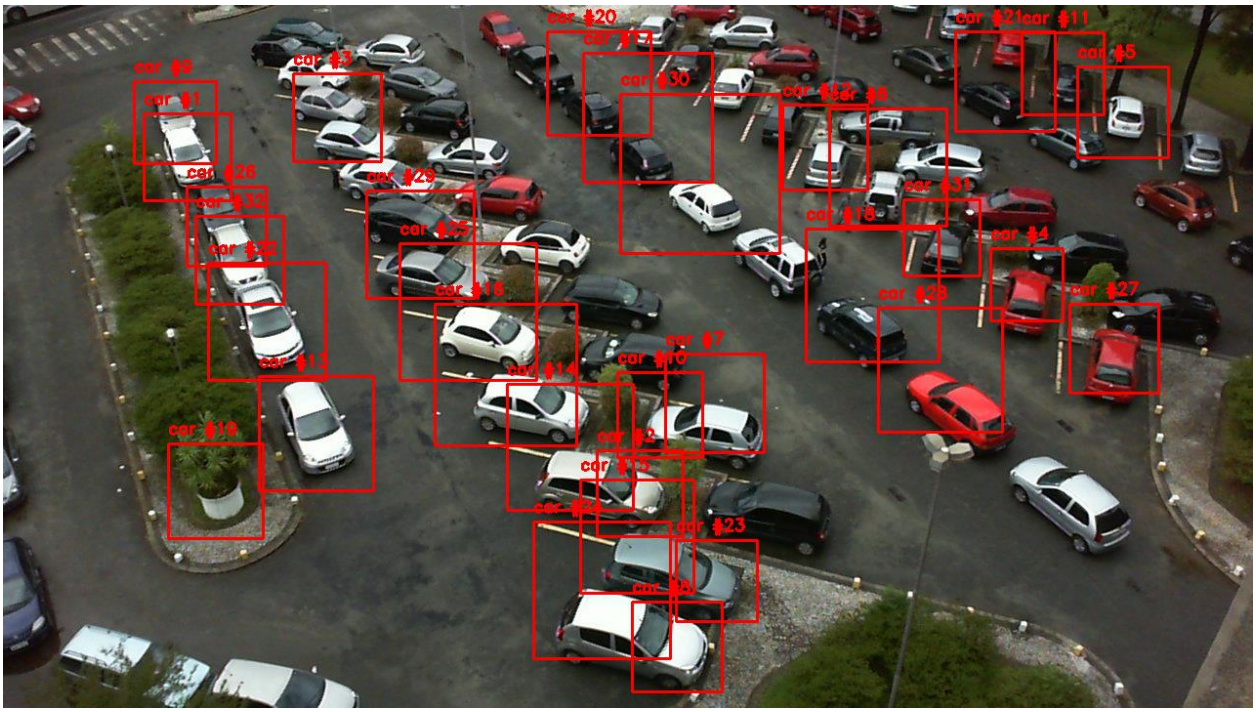
a. Use images from rainy and cloudy datasets to test your algorithm

used images like these from rainy and cloudy dataset

Rainy dataset image



Cloudy dataset image



b. Write a python program that takes the cascade classifier parameters as input and a test image (from rainy and cloudy datasets) and performs car detection

The Program for Car Detection “cardetection.py” is attached with the report .

c. Test your detection using both sets of features, Haar and LBP

Car Detection using HAAR classifier

Image from sunny dataset - HAAR classifier

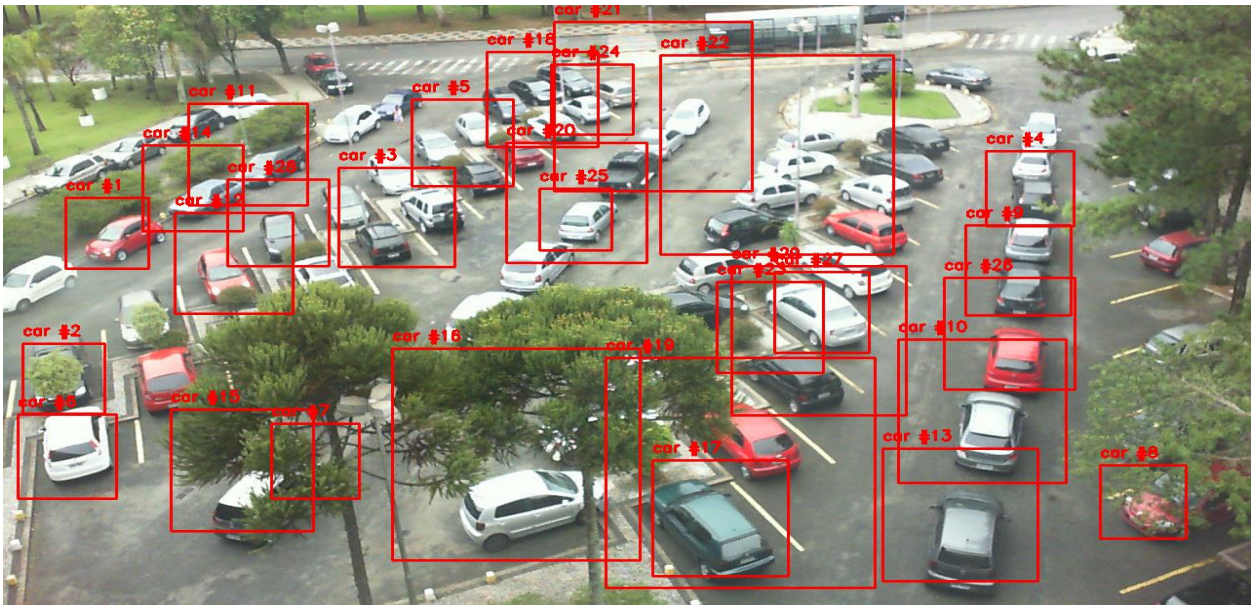



Image from Cloudy dataset - HAAR classifier

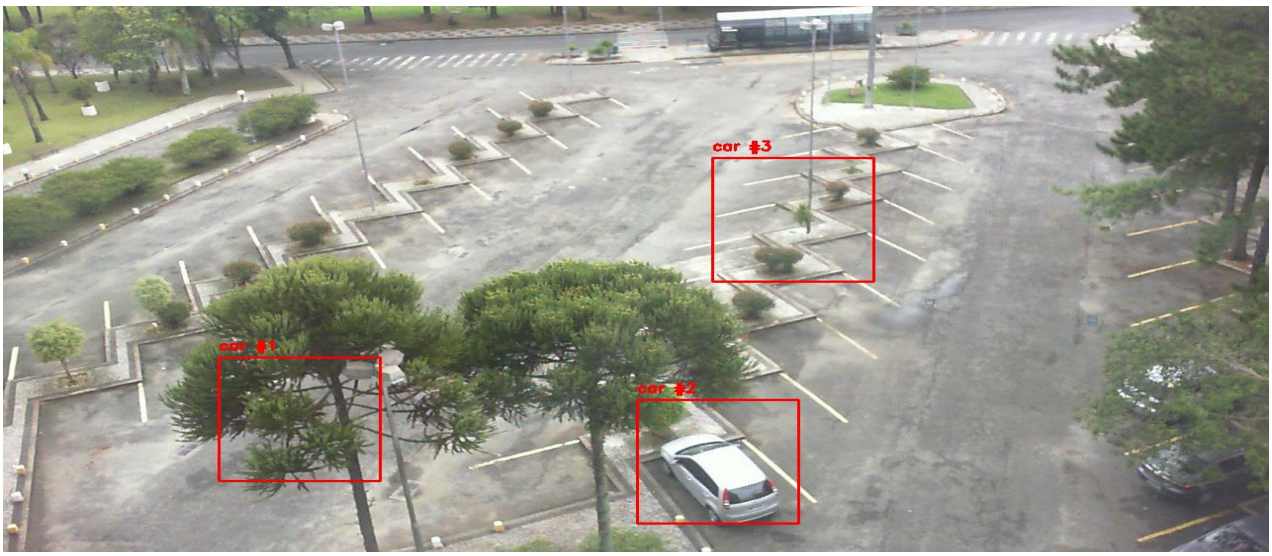


Image from rainy data set- HAAR classifier


LBP classifier

Image from sunny dataset- LBP classifier

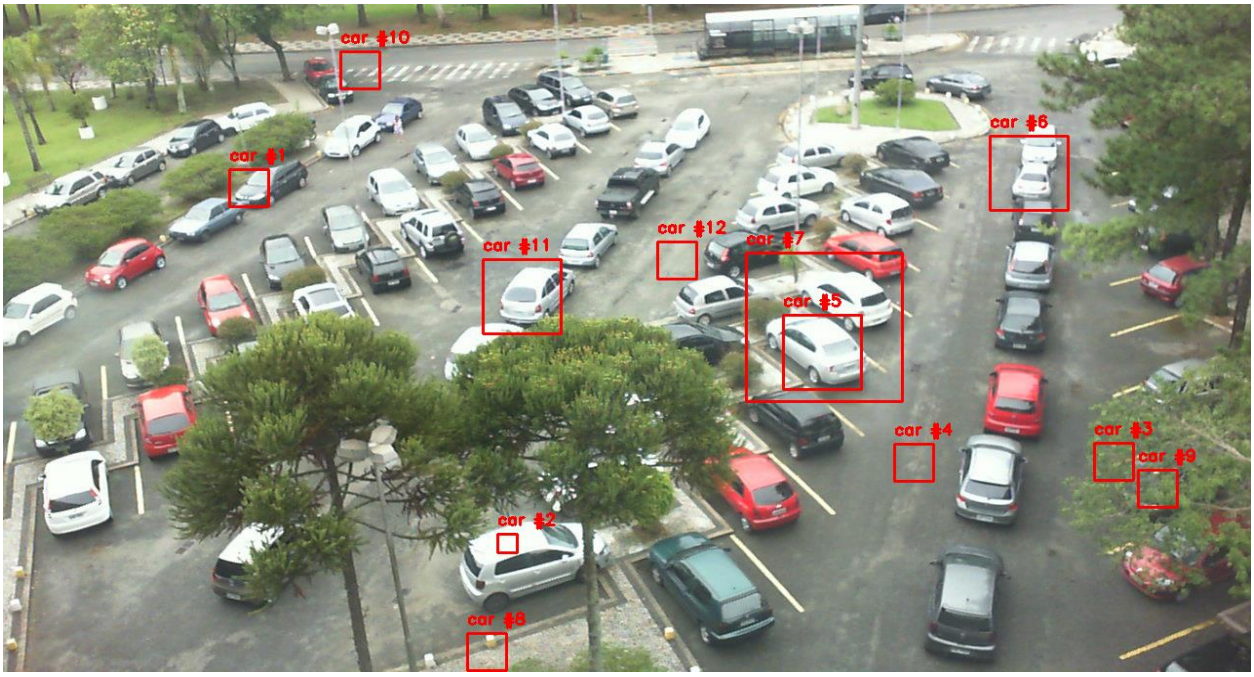


Image from Cloudy dataset - LBP classifier

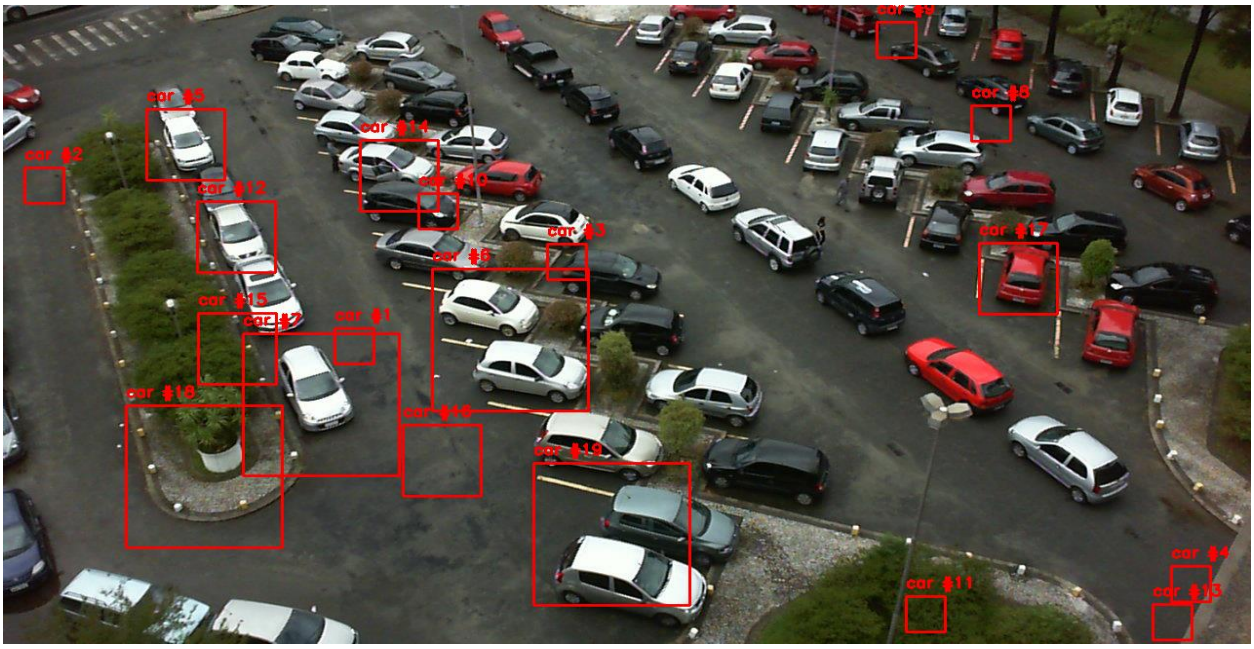
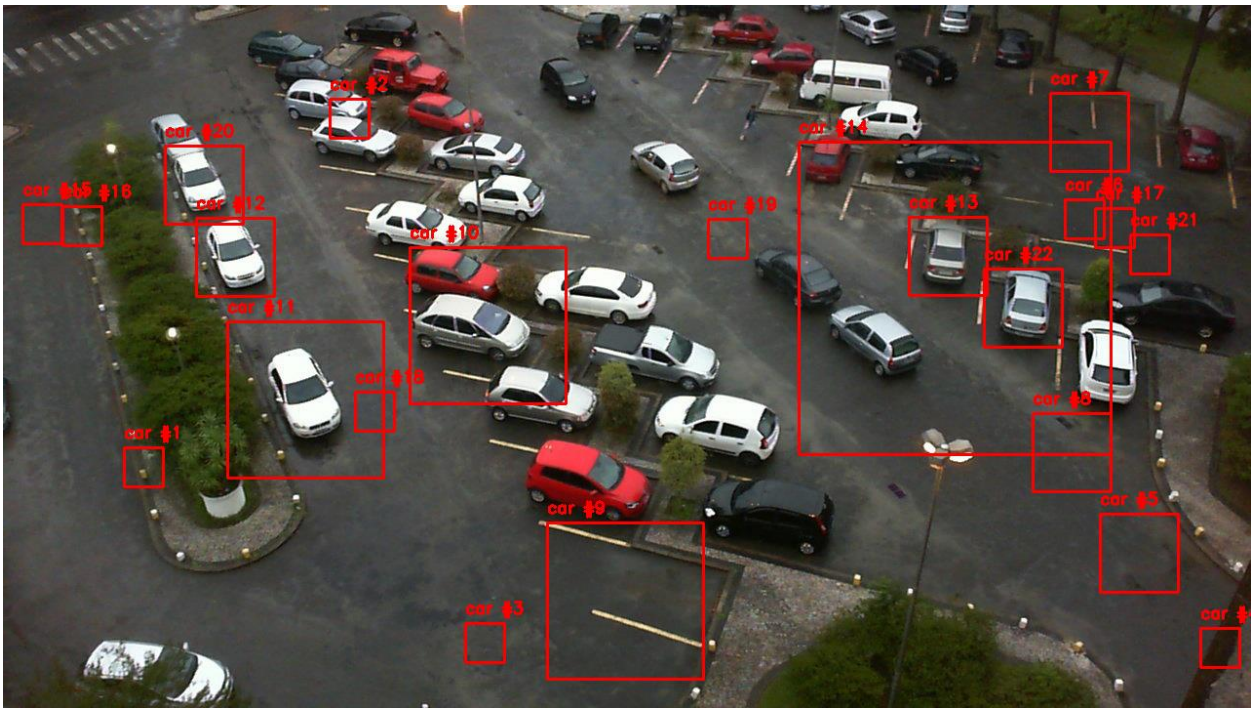



Image from rainy data set – LBP classifier




4. Parking lot analysis

a. Using the detected cars, and the location of the parking spots, determine, if a parking spot is occupied or empty.

b. Use the ground truth to compare and summarize your results.

i. Test 25 images each from rainy and cloudy (total 50 tests) dataset and report the true positives, false positive, accuracy.

The following images are considered


2012-09-16_06_22_55


2012-09-16_08_17_59


2012-10-23_09_00_52


2012-11-09_07_56_35


2012-11-09_08_06_36


2012-11-09_10_51_44


2012-11-10_06_32_38


2012-11-10_10_47_50


2012-12-07_16_42_25


2012-12-07_16_52_25


2012-12-14_07_40_02


2012-12-14_07_45_02


2012-12-14_07_50_03


2012-12-14_08_15_03


2012-12-14_08_20_03


2012-12-15_16_55_14


2012-12-15_17_20_14


2013-01-16_16_15_12


2013-01-16_16_20_12


2013-01-18_16_45_13


2013-01-18_17_0


2013-02-26_13_0


2013-02-26_13_1


2013-04-12_17_4


2013-04-12_17_5

Cloudy image data set


2012-09-12_06_20_57


2012-09-12_07_23_35


2012-09-12_07_28_48


2012-09-12_09_50_14


2012-10-14_08_44_42


2012-10-14_16_10_02


2012-11-08_07_00_26


2012-11-08_18_15_58


2012-11-08_18_45_59


2012-11-08_19_31_02


2012-12-12_11_50_07


2012-12-14_09_35_05


2012-12-14_10_10_06


2013-01-22_12_20_07


2013-01-22_12_45_08


2013-01-22_13_15_08


2013-02-22_17_40_12


2013-02-22_17_55_12


2013-02-22_18_35_13


2013-03-13_06_55_01


2013-03-13_07_40_02


2013-03-20_06_50_01


2013-04-14_10_05_04


2013-04-14_10_30_05


2013-04-14_10_55_05

The output for these Images for HAAR classifier is as follows

HAAR classifier rainy


20180403-230701


20180403-230714


20180403-230715


20180403-230716


20180403-230717


20180403-230718


20180403-230719


20180403-230720


20180403-230721


20180403-230722


20180403-230723


20180403-230724


20180403-230725


20180403-230755


20180403-230756


20180403-230757


20180403-230805


20180403-230806


20180403-230826


20180403-230827


20180403-230828


20180403-230856


20180403-230857


20180403-230904


20180403-230905

HAAR classifier cloudy


20180403-230151


20180403-230152


20180403-230153


20180403-230207


20180403-230208


20180403-230209

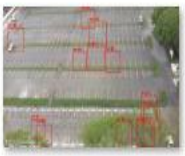

20180403-230219


20180403-230220


20180403-230235


20180403-230236


20180403-230237


20180403-230249


20180403-230250


20180403-230251


20180403-230304


20180403-230305


20180403-230321


20180403-230322


20180403-230508


20180403-230509


20180403-23052


20180403-23053


20180403-23053


20180403-23054


20180403-23054

LBP rainy


20180403-231156


20180403-231157


20180403-231158


20180403-231201


20180403-231202


20180403-231203


20180403-231206


20180403-231207


20180403-231210


20180403-231211


20180403-231212


20180403-231215


20180403-231216


20180403-231224


20180403-231225


20180403-231228


20180403-231229


20180403-231235


20180403-231236


20180403-231237


20180403-23124

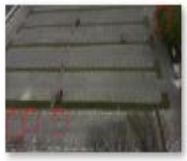

20180403-23124


20180403-23124


20180403-23125


20180403-23125

LBP cloudy


20180403-230954


20180403-230955


20180403-230956


20180403-230957


20180403-230958


20180403-231004


20180403-231005


20180403-231006


20180403-231008


20180403-231009


20180403-231010


20180403-231013


20180403-231014


20180403-231015


20180403-231017


20180403-231018


20180403-231019


20180403-231027


20180403-231028


20180403-231029


20180403-23103

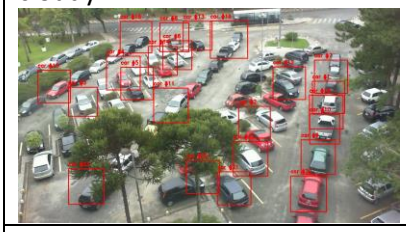
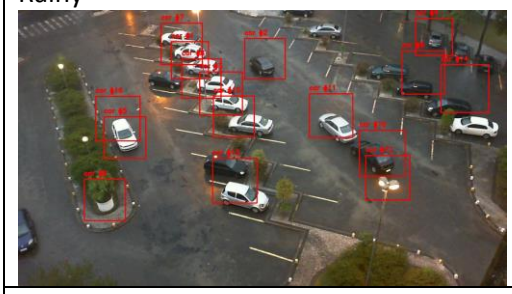
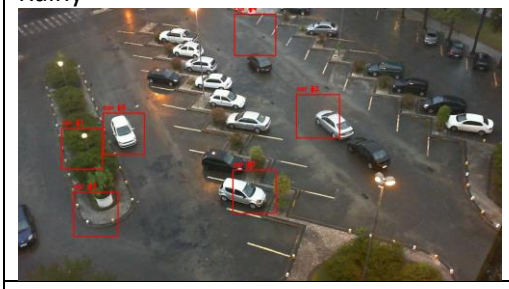
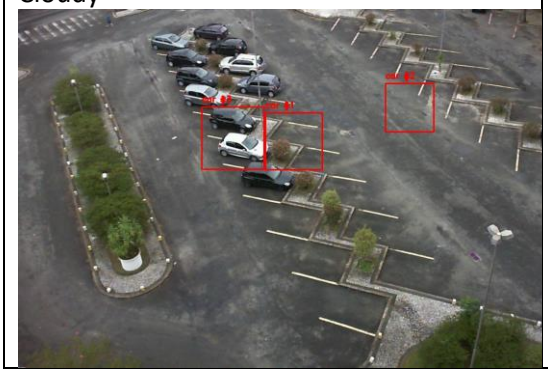

20180403-23103


20180403-23103


20180403-23104


20180403-23112

Question 4.

| Test image | Classifier Feature | Training | | | TP | FP | Accuracy |
|---|---|---|---|---|---|---|---|
| | | Stages | No. of Positives | No. of Negatives | | | |
| cloudy  | HAAR | 10 | 20,000 | 10,000 | 23 | 0 | 23/50=46 % |
| Rainy  | HAAR | 10 | 20,000 | 10,000 | 15 | 2 | 15/21=0.7142 |
| Rainy  | LBP | 10 | 40,000 | 20,000 | 4 | 3 | 4/21=0.19 |
| Cloudy  | LBP | 10 | 40,000 | 20,000 | 1 | 2 | 1/10=0.1 |

Have attached the files containing the test image data set and output data set for each of the classifiers with the report and have included the python files for all the programs

Thanks and Regards

Lavanya.s.s