Traffic Sign Detection With Cell Phone Data

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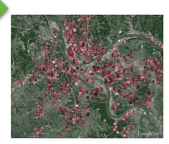
Introduction


application

Automatic driving

Road management

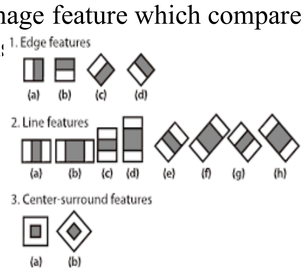
Traffic sign detection

- **Problem:**
  Data collection: time-consuming
  Not many database available for all American **traffic signs.**
  Most studies **concentrate on** speed limit signs
- **Objective**:
  Train a detector which can detect most of **common traffic signs**

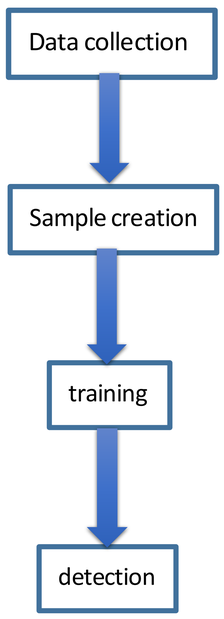
Methods

We use **Haar-like feature** as the basic feature of classifier combined with **Adaboost** algorithm.

- HAAR-like feature is digital image feature which compare **difference** of the **sum of pixels** inside the Rectangle and use it to **categorize** subsection of images
- AdaBoost is an algorithm for constructing a ”**strong**” classifier as linear combination of “simple” “weak” classifiers.



Research process




by a camera mounted in the car


source image

sample

```
===== TRAINING 1-stage =====
<BEGIN
POS count : consumed   1000 : 1000
NEG count : acceptanceRatio    3000 : 0.497347
Precalculation time: 12.246
+----+---------+---------+
|  N |    HR   |    FA   |
+----+---------+---------+
|   1|        1|        1|
+----+---------+---------+
|   2|        1|        1|
+----+---------+---------+
|   3|        1|        1|
+----+---------+---------+
|   4|        1| 0.530667|
+----+---------+---------+
```

Detection test and Results

1. Single sign Detection

Goal: Find reasonable parameters by small sample training

	w	h	detect
data1	16	16	37
data2	16	20	38
data3	20	20	22

	minHitRate	maxFalseAlarmRate	detect	miss
data1	0.995	0.5	22	25
data2	0.995	0.6	28	19
data3	0.995	0.7	12	35
data4	0.996	0.6	30	17
data5	0.998	0.6	40	7

Results:

- Ratio of width to height of positive sample: **similar to** its actual ratio
- MinHitRate and maxFalseAlarmRate have a great **influence** on the classifier’s detection result (minHitRate:0.998 with maxFalseAlarmRate:0.6 is recommended here based on our test)

2. Mixed signs Detection

Goal: Verify the classifier’s performance while sample dataset contains different categories.

Very different features!

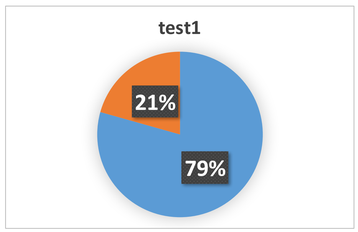
	stop signs		speed limit signs	
	detected	missed	detected	missed
stop signs only	27	2		
speed limit signs only			52	1
both(16 16)	27	2	34	19
both(16 20)	28	1	48	5

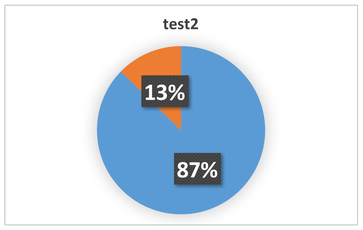
Results:

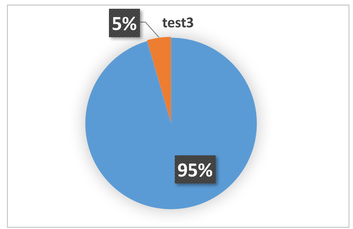
- Basically the classifier could identify different signs as long as each category has enough different samples.
- The size of traffic sign samples should be taken into consideration when training a clssifier with different signs.

Solution to lac of samples&improving classifier’s performance

- **Problem**
  Some signs in the test images are missed by the classifier
- **Solution** Boosting(add false negative test samples and retrain the classifier)







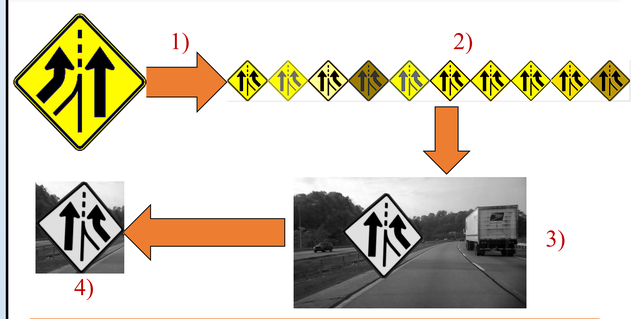
missed
detected

test1:create from 5 speed limit signs
test2:create from 10 speed limit signs
test3:applying boost train in test3

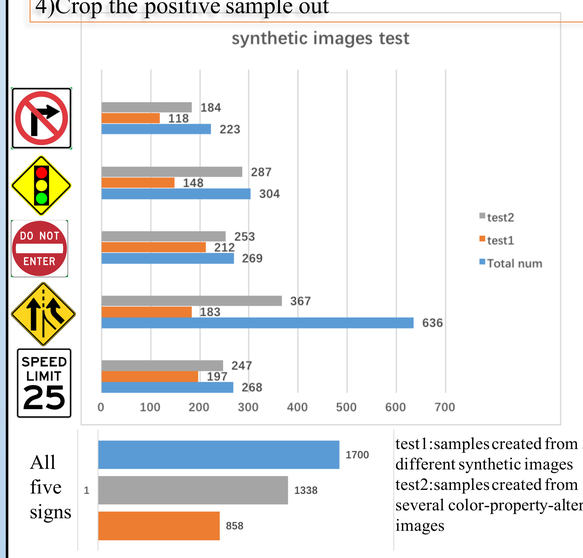
- **Problem:**
  Do not have enough samples of some signs
- **Solution**
  Create many different samples from one picture by opencv_createsamples

Results:

- Classifier's accuracy would generally be **risen up** with more image samples with different features added to the sample set.
- Boosting could improve the classifier’s performance in an efficient way.
- **Improved method**:
  Creating 10 images from one synthetic image by changing its property(exposure, contrast, saturation.)



1)Original sample
2)Create 10 different samples
3)Place the sample on a background
4)Crop the positive sample out



test1:samples created from 5 different synthetic images
test2:samples created from several color-property-altered images

Results:

- After applying the new method above, most of the classifier’s test performance has a huge promotion.

Conclusion

The Classifier’s performance depends on the test object’s shape, sample quality, parameters and so on. By applying methods like creating samples from synthetic image and boosting, we can train a classifier which could finally detect variety of common signs both accurately and at low cost.

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