# Using Machine Learning to Detect Yellow Lines on the Road

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## Introduction

●The objective of my work is to design an algorithm to detect yellow lines on the road. The algorithm should be robust and can be adapted to different situations.

● Yellow lines are important on the road since they provide drivers valuable guidance. However, little work has addressed the robust detection of these markers. My work is motivated by the need to detect these lines automatically for maintenance purposes.

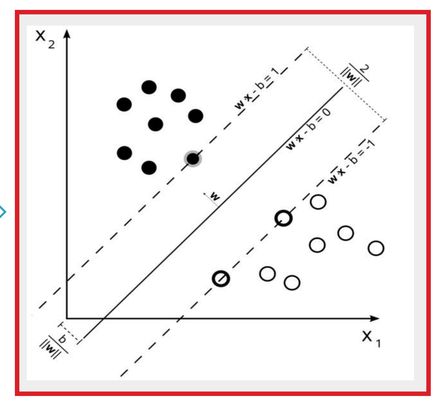
## Data collection

To detect yellow lines using machine learning, I need a large number of images which have yellow lines on the road in my training system. An android application is created for data collection. We use an Samsung Galaxy Camera mounted in cars to take images or videos when the cars run.


## Classification Method

### Support Vector Machine

The Support Vector Machine (SVM) is a common method of machine learning which is widely used to do classification. Given a set of training examples, each marked as belonging to one of two categories, an SVM training algorithm builds a model that decides whether new examples belong to one category or the other.




## Training

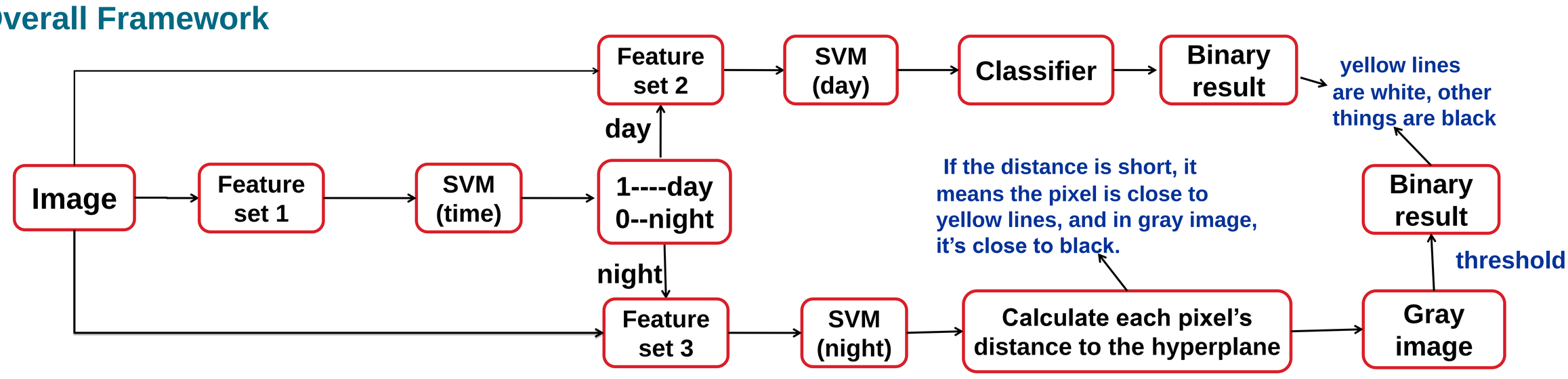
To train the classifier, I need many examples of yellow lines, and a large number of examples of other objects in the image. I labeled a set of images using ‘LabelMe’, as shown below:

The binary mask is obtained using Matlab. The yellow lines that I labeled are shown in white, and other things are indicated in black.

I use ‘libsvm’ toolbox to train the classifiers. Cross-Validation was used to validate the models obtained.

## Detection and Results

### Overall Framework

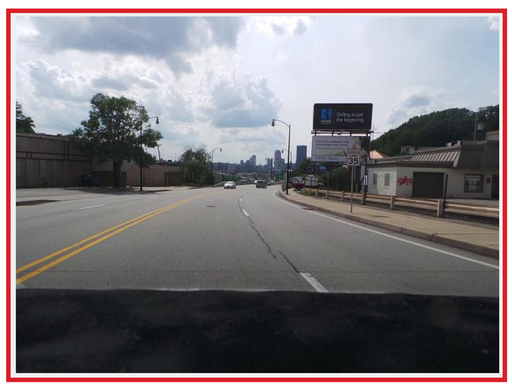



| Feature set 1 | Feature set 2 | Feature set 3 |
|---|---|---|
| Mean H,S,V,R,G,B values of the image<br>The Proportion of:{H,S}<0.2; {R,G,B}<20;{R,G,B}>250 | H,S values of each pixel | H,S,V values of each pixel<br>Filtered image’s pixels |

### Time detection results

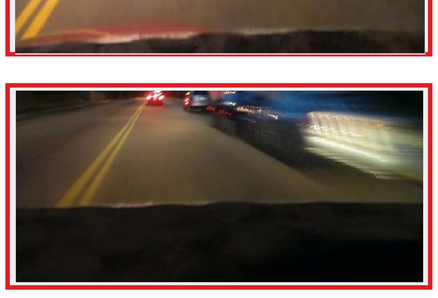
On a test set of about 40 images, the time-of-day detection classifier achieved 100% accuracy. That means the SVM classify all the day images into category “1” and all the night images into category “0”.

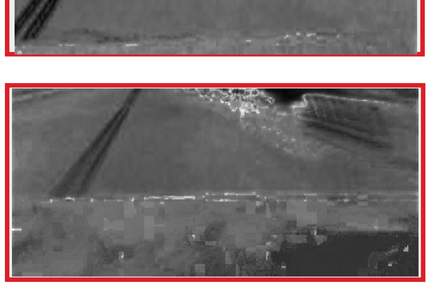
### Daytime classification results



On a test set of about 40 daytime images, the yellow line detection classifier achieved 95% accuracy. That means the daytime classifier is acceptable.

### Nighttime classification results





On a test set of about 40 images at night, half of the results are as good as those at daytime. But others are not mainly because of the influence of streetlights. Nearly 20% of the pixels that are not from yellow lines are classified into white and some pixels that are from yellow lines are classified into black. This suggests that more features need to be added.

## Conclusion

Designed a methodology to detect yellow lines on the road, which is capable of operation at both day and night. While detection performance during the day is acceptable, future work needs to address the influence of streetlights in order to improve classification accuracy during the night.

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