Traffic sign detection

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Data

4 different data sources:

Swedish road signs.

German road signs.

Russian road signs.

Belgian road signs.

Plan

- Extract road signs from images and build road sign classifier.
- Build road sign detection model/algorithm.
- Combine the two models.

Classifying signs (1)

- Need for computational power - HPC Rocket Cluster
- Labelling some unlabeled signs ~ 1.3 thousand
  - CNN & manually
- Preprocessing the images
  - resizing
  - CLAHE algorithm
- 53 360 labelled signs
- 78 classes

Classifying signs (2)

- Final model
- Metrics:
  - Training accuracy: 98.88 %
  - Validation accuracy: 98.58 %
  - ROC-AUC: 99.99% (train + val)
- Preprocessing images resulted in + 1.5 % gain in accuracy

Layer (type)	Output Shape	Param #
conv2d_5 (Conv2D)	(None, 50, 50, 8)	608
activation_8 (Activation)	(None, 50, 50, 8)	0
batch_normalization_7 (Batch	(None, 50, 50, 8)	32
max_pooling2d_3 (MaxPooling2	(None, 25, 25, 8)	0
conv2d_6 (Conv2D)	(None, 25, 25, 16)	1168
activation_9 (Activation)	(None, 25, 25, 16)	0
batch_normalization_8 (Batch	(None, 25, 25, 16)	64
conv2d_7 (Conv2D)	(None, 25, 25, 16)	2320
activation_10 (Activation)	(None, 25, 25, 16)	0
batch_normalization_9 (Batch	(None, 25, 25, 16)	64
max_pooling2d_4 (MaxPooling2	(None, 12, 12, 16)	0
conv2d_8 (Conv2D)	(None, 12, 12, 32)	4640
activation_11 (Activation)	(None, 12, 12, 32)	0
batch_normalization_10 (Batc	(None, 12, 12, 32)	128
conv2d_9 (Conv2D)	(None, 12, 12, 32)	9248
activation_12 (Activation)	(None, 12, 12, 32)	0
batch_normalization_11 (Batc	(None, 12, 12, 32)	128
max_pooling2d_5 (MaxPooling2	(None, 6, 6, 32)	0
flatten_2 (Flatten)	(None, 1152)	0
dense_3 (Dense)	(None, 128)	147584
activation_13 (Activation)	(None, 128)	0
batch_normalization_12 (Batc	(None, 128)	512
dropout_2 (Dropout)	(None, 128)	0
flatten_3 (Flatten)	(None, 128)	0
dense_4 (Dense)	(None, 128)	16512
activation_14 (Activation)	(None, 128)	0
batch_normalization_13 (Batc	(None, 128)	512
dropout_3 (Dropout)	(None, 128)	0
dense_5 (Dense)	(None, 78)	10062
activation_15 (Activation)	(None, 78)	0

Total params: 193,582

Classifying signs (3)

When correct

label	strength
GO_STRAIGHT_OR_TURN_RIGHT	0.999996
GIVE_WAY	0.999994
GIVE_WAY_TO_ONCOMING	0.999991

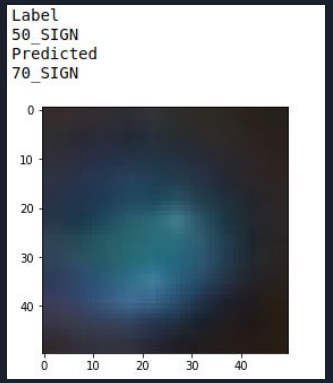
When wrong

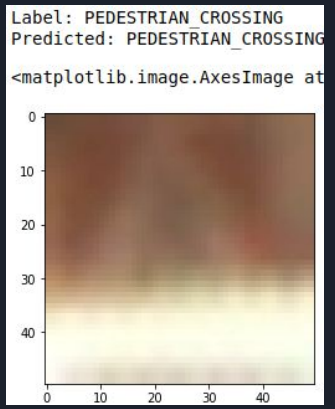
label	strength
PASS_LEFT_SIDE	0.999841
OTHER	0.999806
PRIORITY_ROAD	0.999745

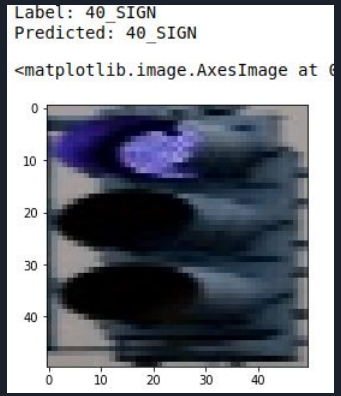
WIDTH_LIMIT	0.917532
130_SIGN	0.917246
15_SIGN	0.862237

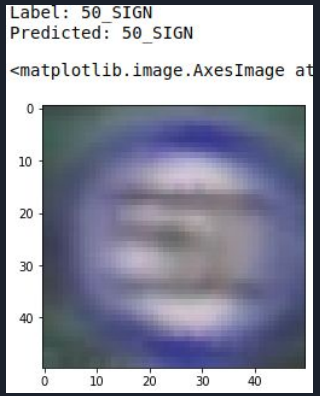
ROUNDABOUT	0.518672
CURVES_FIRST_LEFT	0.512989
NO_OVERTAKING_END	0.464633

Classifying signs (4)

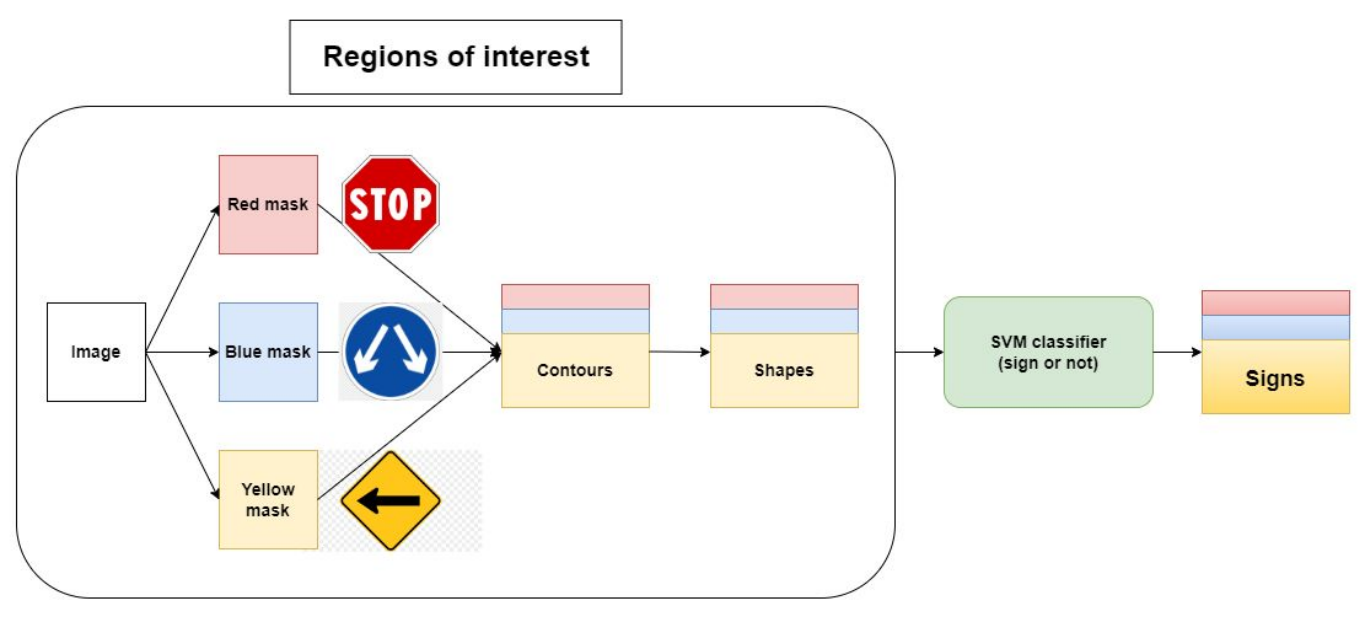






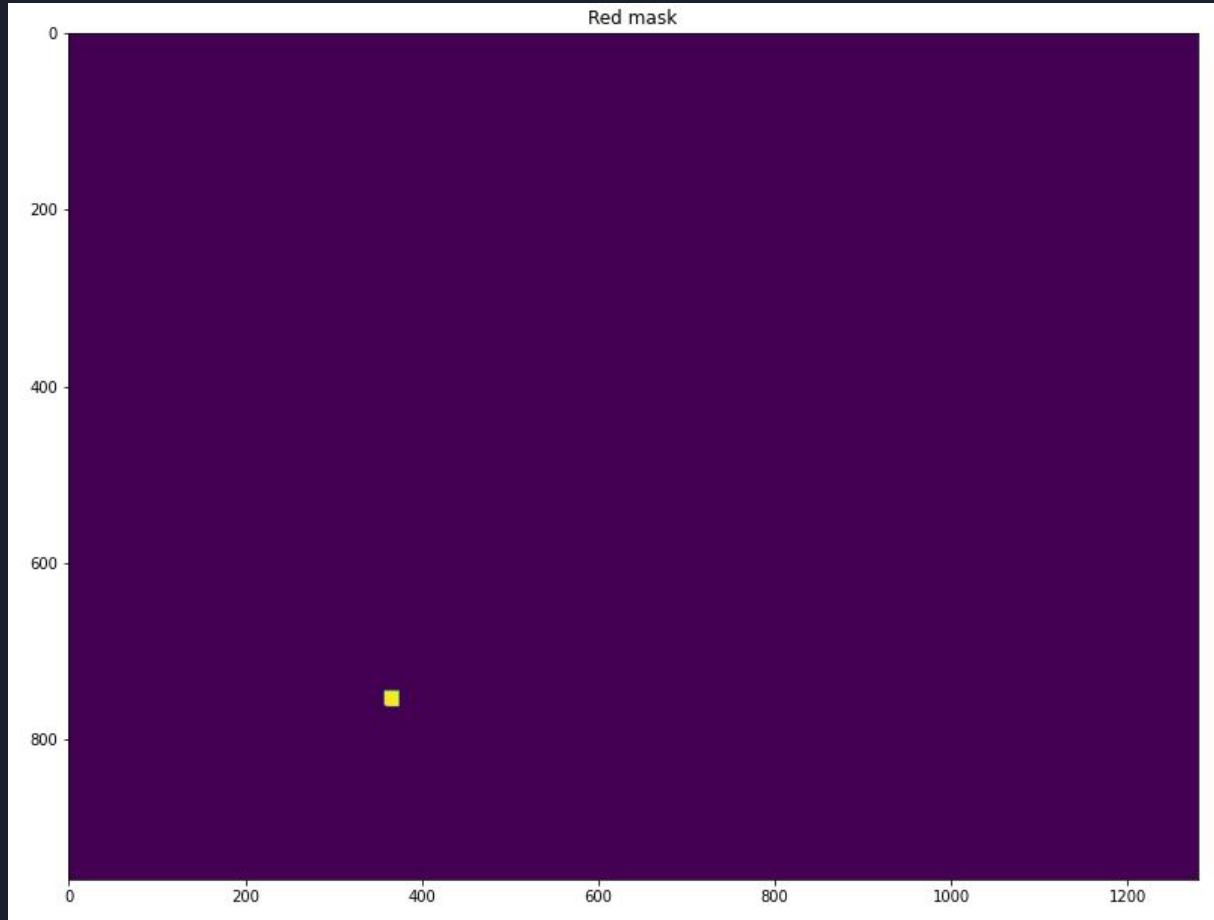


Extracting road signs from images

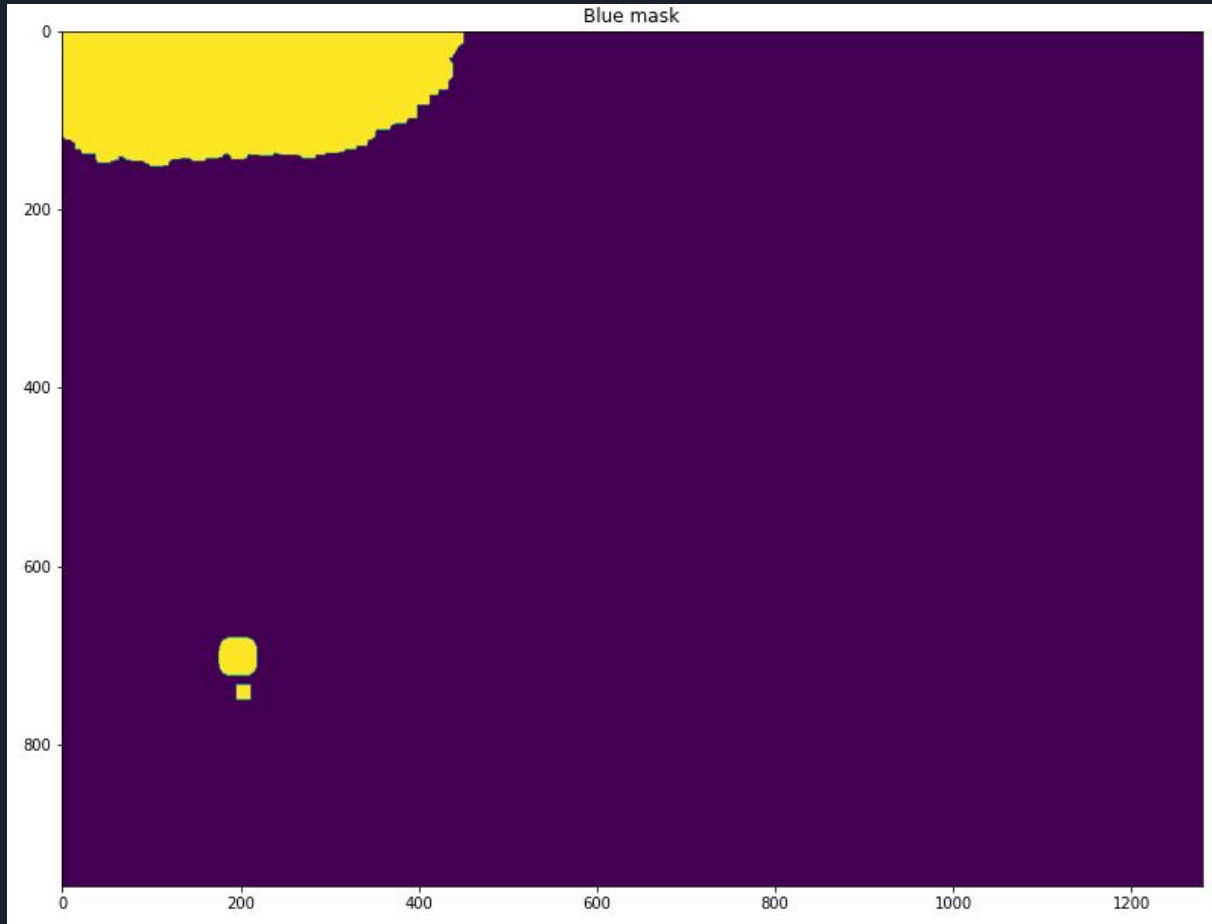


Pipeline

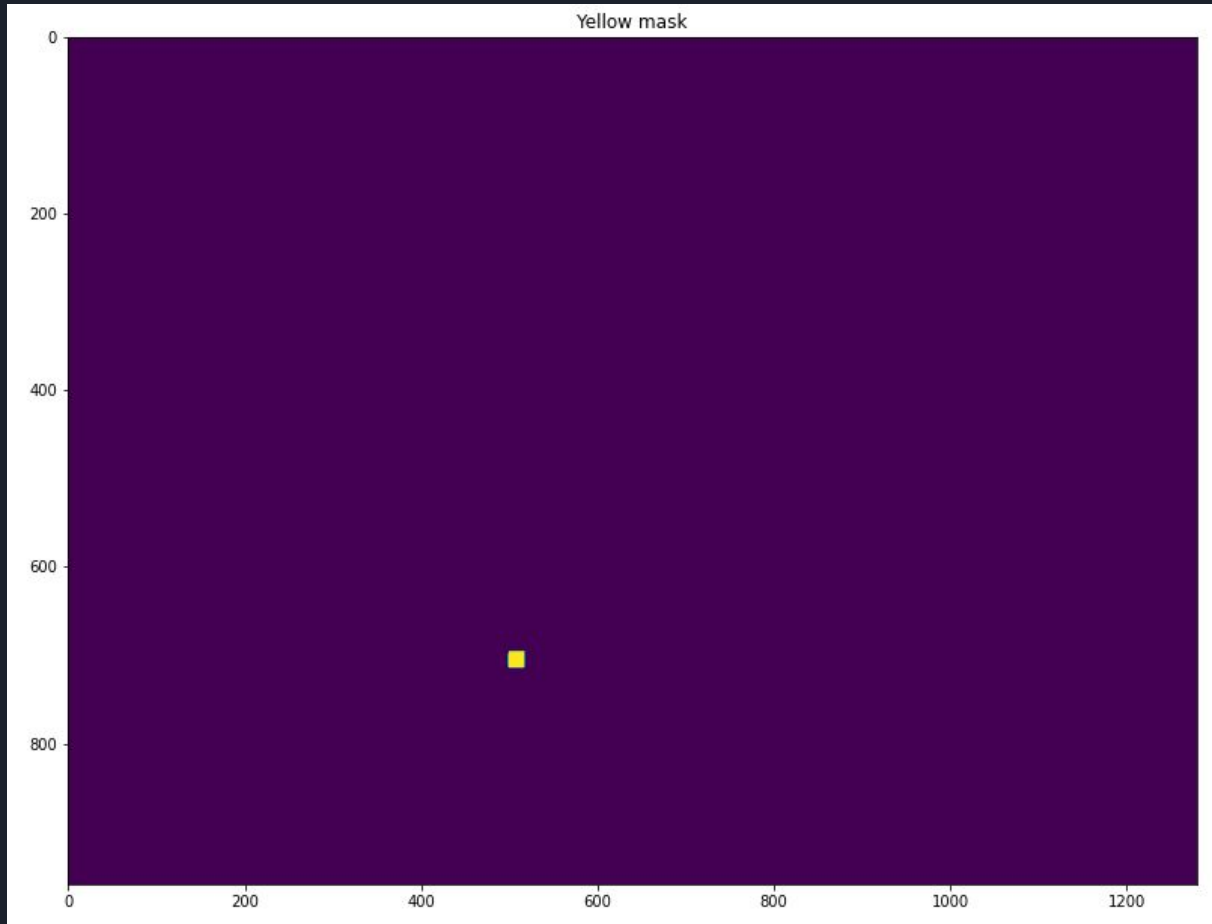
Pipeline



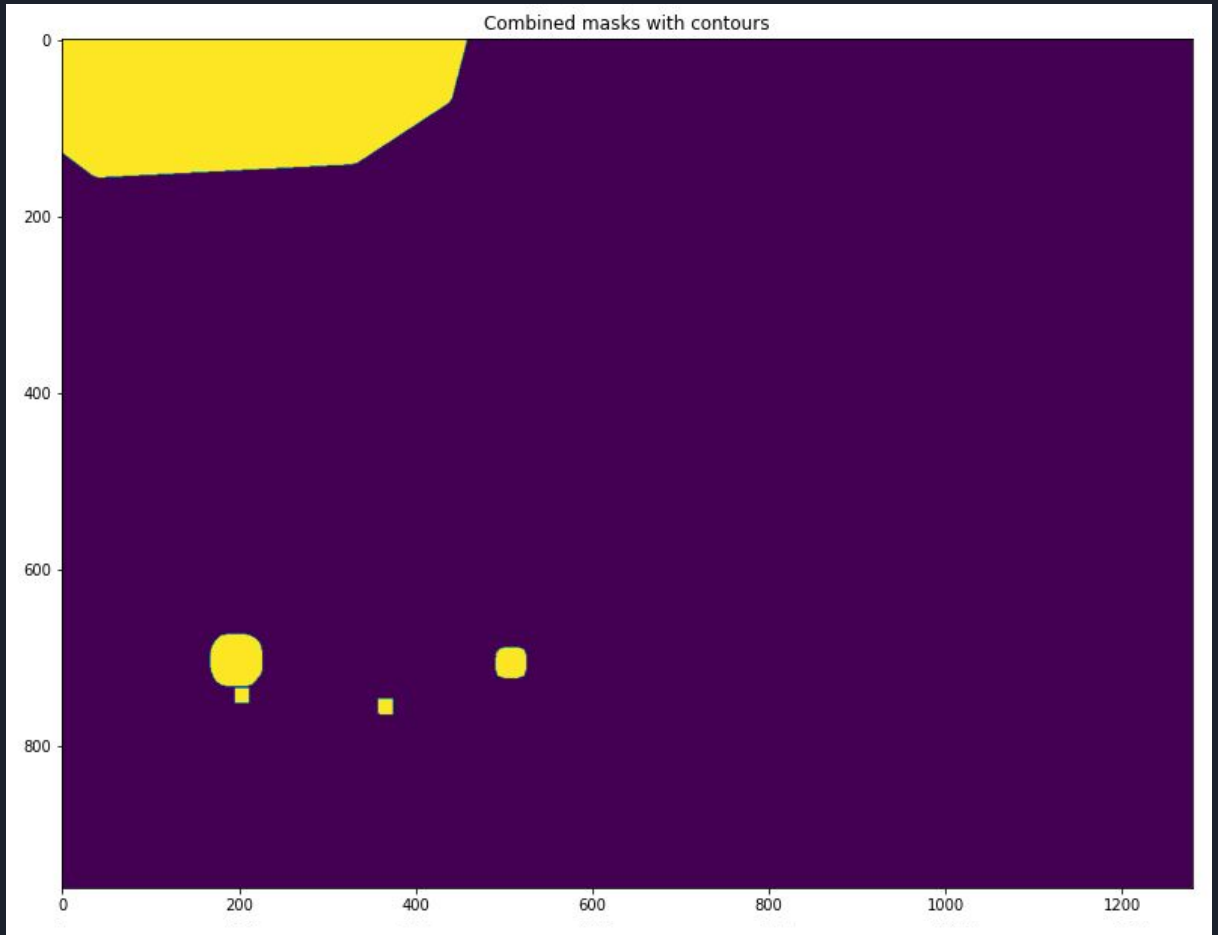
Pipeline



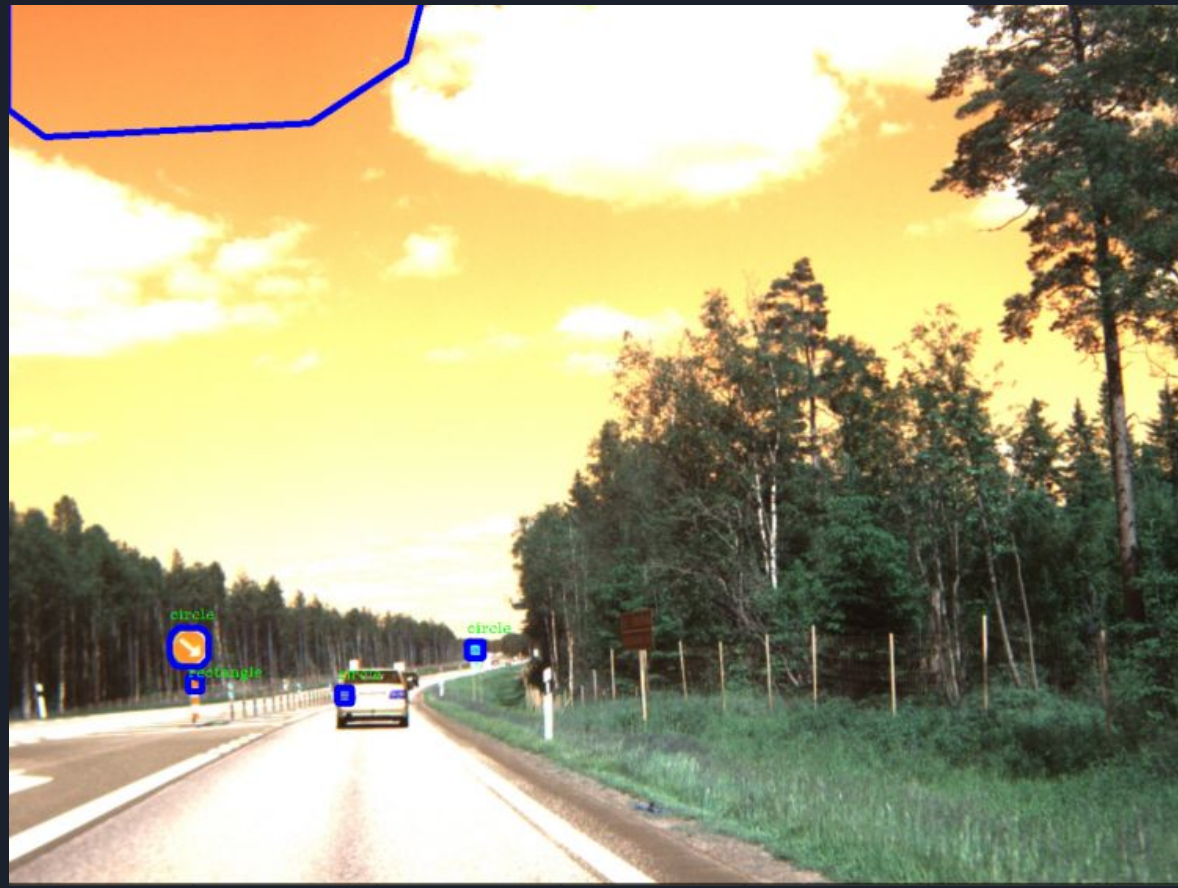
Pipeline



Pipeline


Combined masks with contours
0
200
400
600
800
0
200
400
600
800
1000
1200

Pipeline



Pipeline

Examples

Examples

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Conclusions

- Satisfied with results
- Good experience
- Complex pipelines are hard to join
- Complex parameter tuning is difficult and time-consuming
- Working with images requires A LOT of computing power