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Image Processing : Plate localization

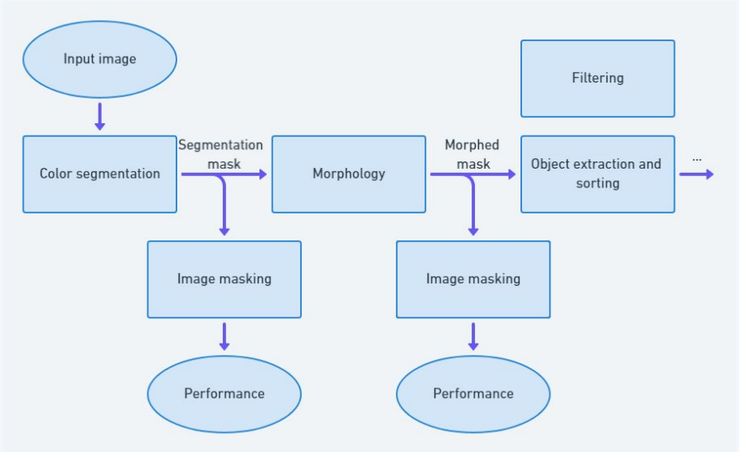
camera stays the same for each input image
> no scaling concerns

General Details

The main objective of this milestone is to localize any vehicle's plate present on an input image.

To do so, we run the image through a series of image processing methods, each bettering the accuracy of our positioning.

The general idea consists of obtaining a binary mask highlighting only the parts of the input image falling within a specified color range.



By tuning the interval to match a yellow plate, we can localize (along with some noise) the general position of the license plate. We then apply a morphological treatment to the mask in order to suppress the small noise in the image and be left with few large regions on the mask. The final step is sort those object and crop the isolated plate.

Color Segmentation

Convert the image to HSV in order to create a mask highlighting input image pixels falling within the following fine tuned range:

$$(H, S, V) \in [\,(10, 60, 40),\ (27, 255, 255)\,]$$

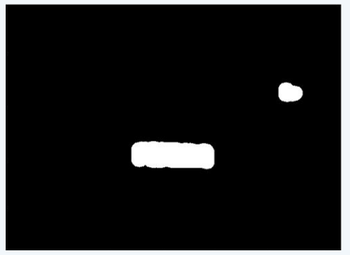
Notice that the initial mask carries noise in addition to the license plate.

As we can however not shrink the color range any further without losing the ability to use the same range on other images, we need some more processing to get rid of the noise.

Morphology

Firstly denoise the image with morphological opening:

Dilate to close the objects:



Object extraction

Discarding objects that weren't deleted by the morphology treatment. We evaluate by size, knowing the minimal dimensions of a plate in a picture.

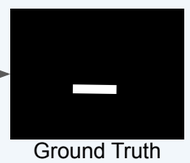
Filtering

We tried to sharpen the image before any other process to have a better accuracy for the plate extraction but the results are unsatisfying.
We however keep it in, in anticipation of better recognition later on in the pipeline.

Performance assessment method

Comparison to a ground truth to evaluate improvement of each new process. We use two different methods for more insight

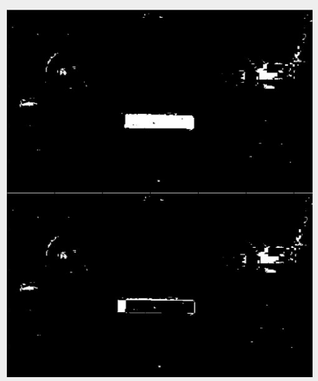
Input



Ground Truth

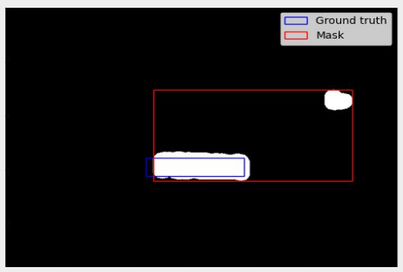
XOR: amount of wrong pixels ↦ 0
IOU: amount of wrong area ↦ 1

XOR



$$P = \frac{\sum(\text{mask XOR GT})}{\sum GT}$$

IOU



$$P = \frac{\text{BoundingArea}(GT \cap \text{Mask})}{\text{BoundingArea}(GT \cup \text{Mask})}$$

Evaluation Results

We evaluate the pipeline with split validation. (Tune the parameters on ⅔ of the design set and evaluate it on ⅓ of the it.)

Color Segmentation			+ Morphology			+ Sorting		
score	XOR	IOU	score	XOR	IOU	score	XOR	IOU
μ	0,41	0,15	μ	0,47	0,53	μ	0,42	0,66
σ	0,29	0,14	σ	0,23	0,31	σ	0,22	0,24

Color segmentation is the basis of our localisation pipeline, but at this stage, the IOU score is mediocre. which is explained by the noise in the mask that increases the GT ∩ Mask area. Adding morphology afterwards, greatly reduces this artefact and yields a 5x better IOU mean score. Lastly, adding sorting discards any leftover objects that escaped the morphological treatment.
Notice however that the mean XOR score stays at an acceptable 0,4 throughout the pipeline. Indeed, the morphology removes noise but also dilates the plate a bit, inflating the XOR score again.