GROUP 1

15/10/2024

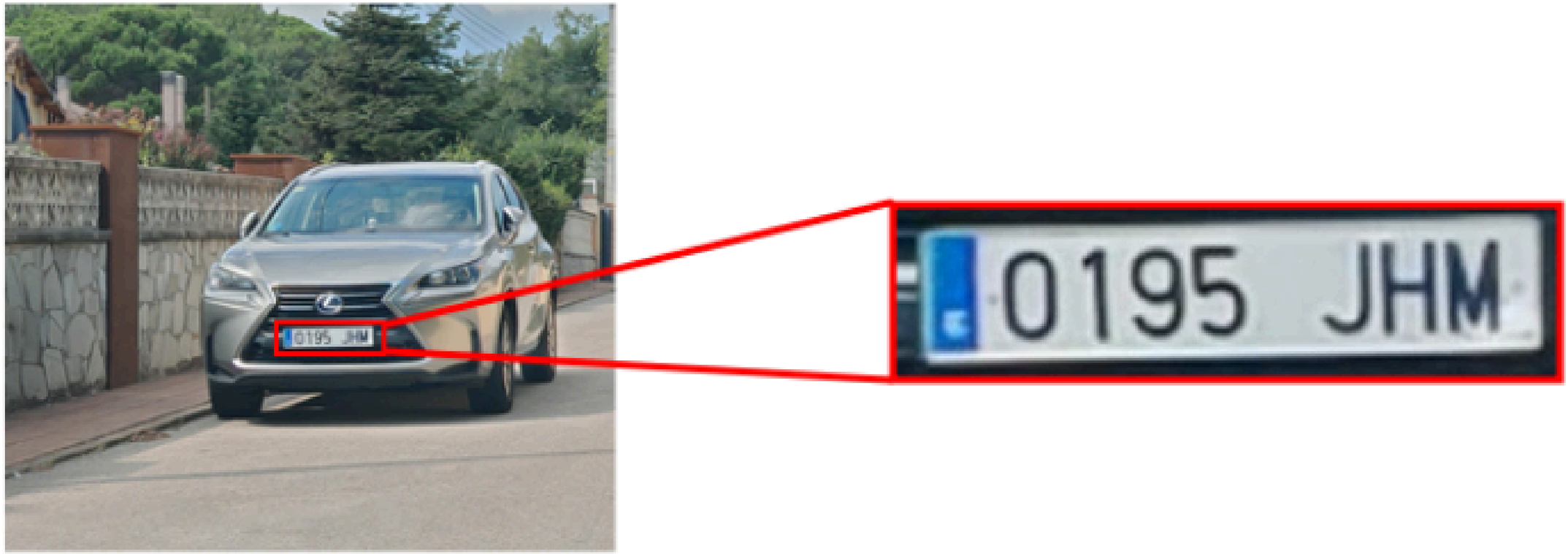
AN-PR

Luis Domene García
Eric López Cervello
Marino Oliveros Blanco

Methodology

Localization

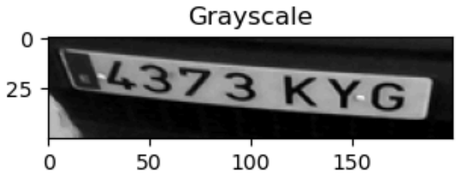
- Used YOLO11
- Roboflow for annotation

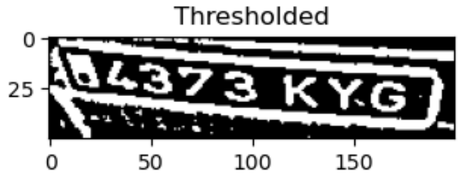


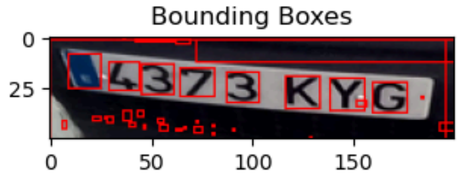
Segmentation

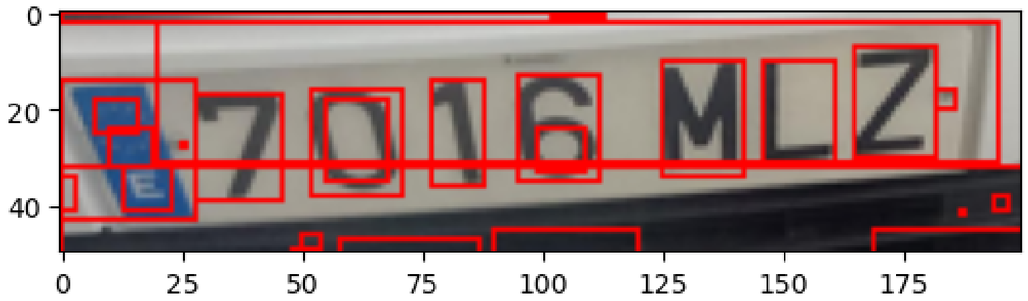
Pre-Processing Notes

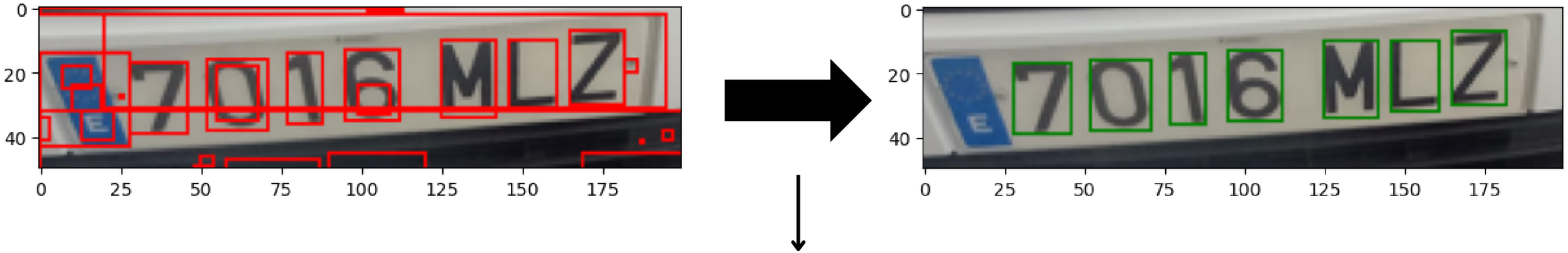
- Resized (200, 50)
- Gaussian Blur
- Adaptive Tresholding







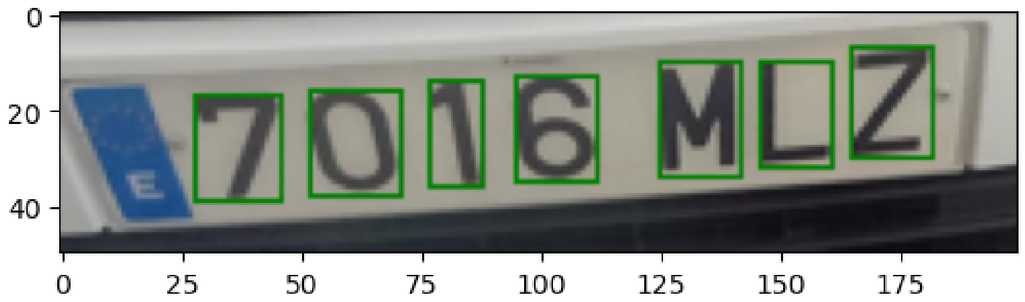


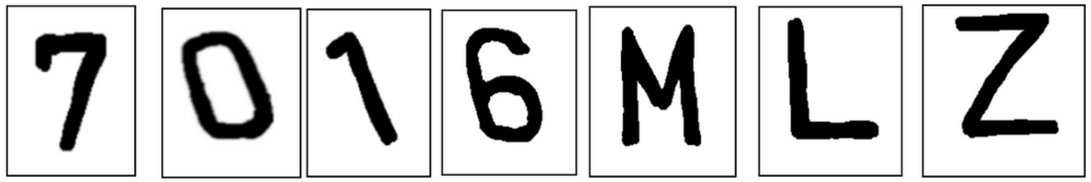


Filters

- Area between 70-800 pixels and aspect ratio (width/height) ranges from 0.1 - 2.0.
- Remove holes inside characters like 6, 8, 9 and 0. These are defined as shapes of smaller area inside their parent shapes.
- Remove blue shapes, like the usual blue box at the left of the license plate.
- Remove blobs.

Recognition





Steps

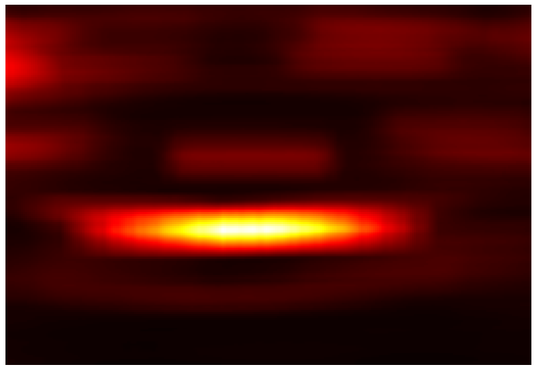
- Binarize the segment (Otsu thresholding)
- Pad the image
- Recognize each segment with PaddleOCR
- Filter characters with confidence < 0.2
- Keep only 0-9 and A-Z

Notes

- Tesseract vs EasyOCR vs PaddleOCR
- Train CNN on EMNIST

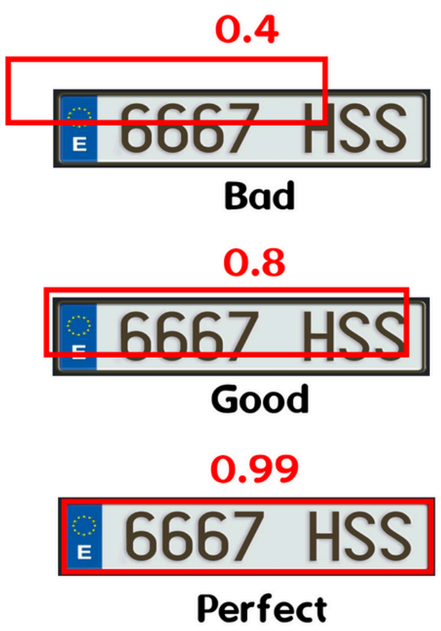
Experiments

YOLO vs Math Morph

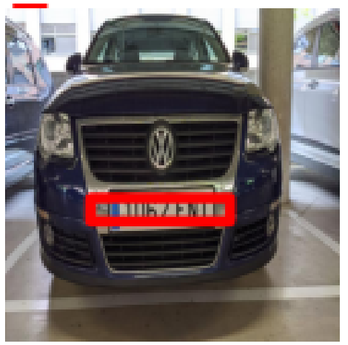


YOLO vs Math Morph

Intersection Over Union
(IOU)



TP



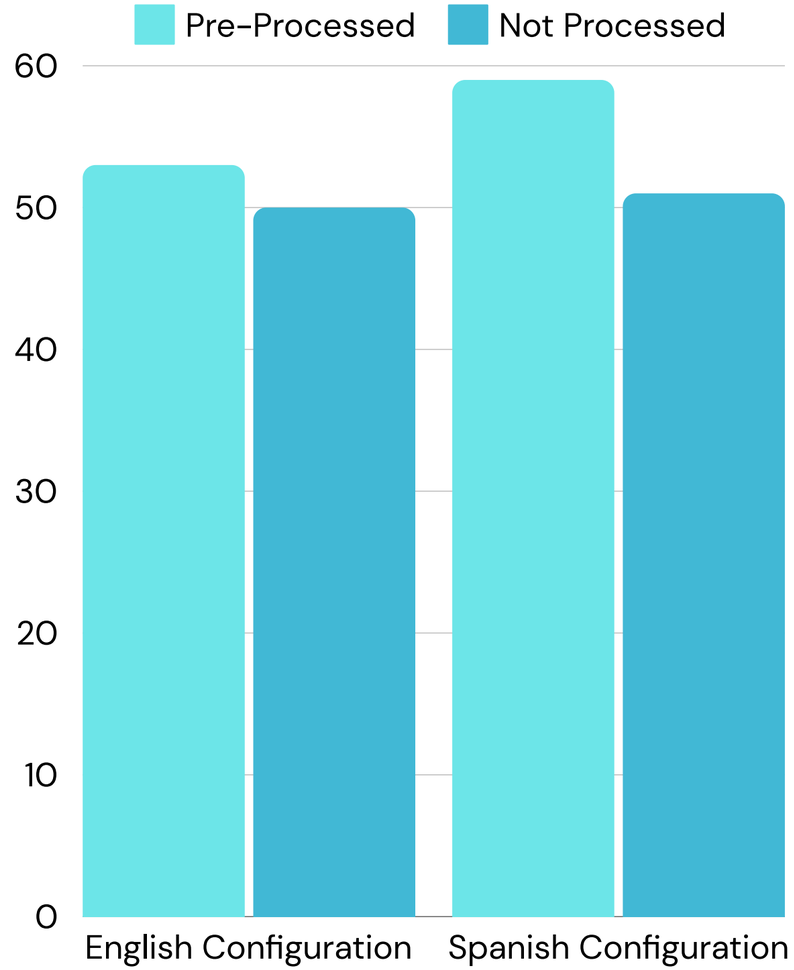
FP

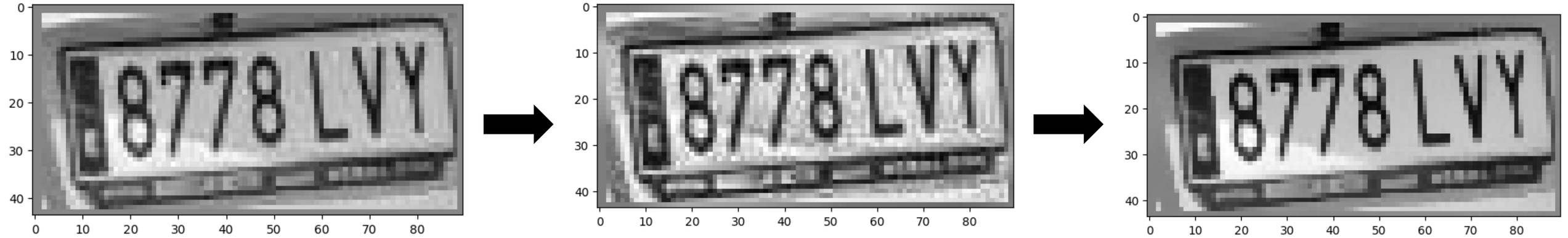
FN

Detection + Recognition

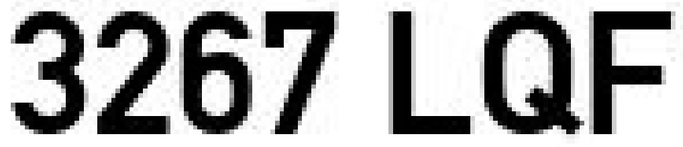
- Directly Apply OCR on the crops.

  - **Preprocessing Impact**
  - **Text similarity scores**: (around 0.5-0.6) revealed unreliable OCR performance.
  - **Test Abandoned:** the approach was discarded for future tests or real-world use.

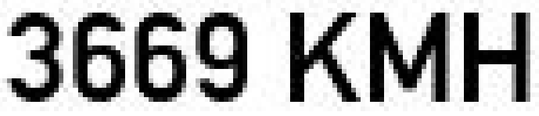


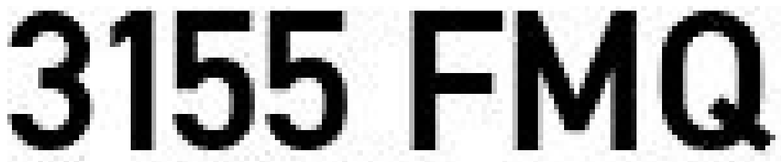

8778 LVY
8778 LVY
8778 LVY

Synthetic Dataset Generation



- Use PIL to create images
  - **Spanish license plate format**
  - Lightweight images: 3-4kb
  - Using appropriate fonts





Results

YOLO vs MathMorph + Template Matching Results

Metric	**YOLO**	**MathMorph + Template Matching**
True Positives	26	10
False Positives	2	16
False Negatives	0	16
Precision (%)	**92,86**	**38,46**
Recall (%)	**100**	**38,46**

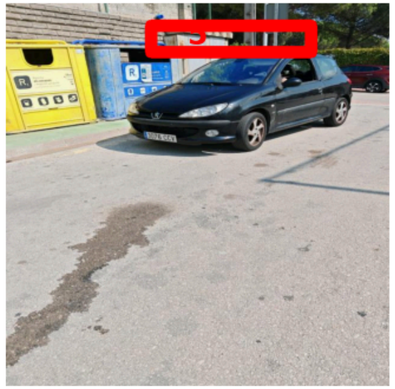

0


1


2


3


4
3044 JMB


5


6


7
3929 GVS

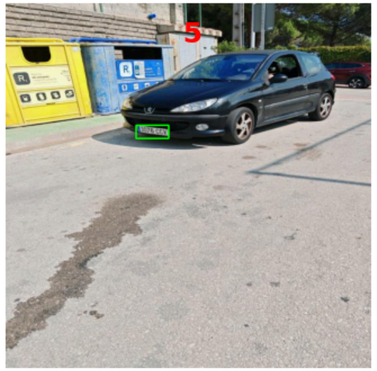

0


1
1062 FNT


2
1111 LRB


3
2929 KXJ


4
3044 JMB


5


6


7
3929 GVS

Recognition and Final Results

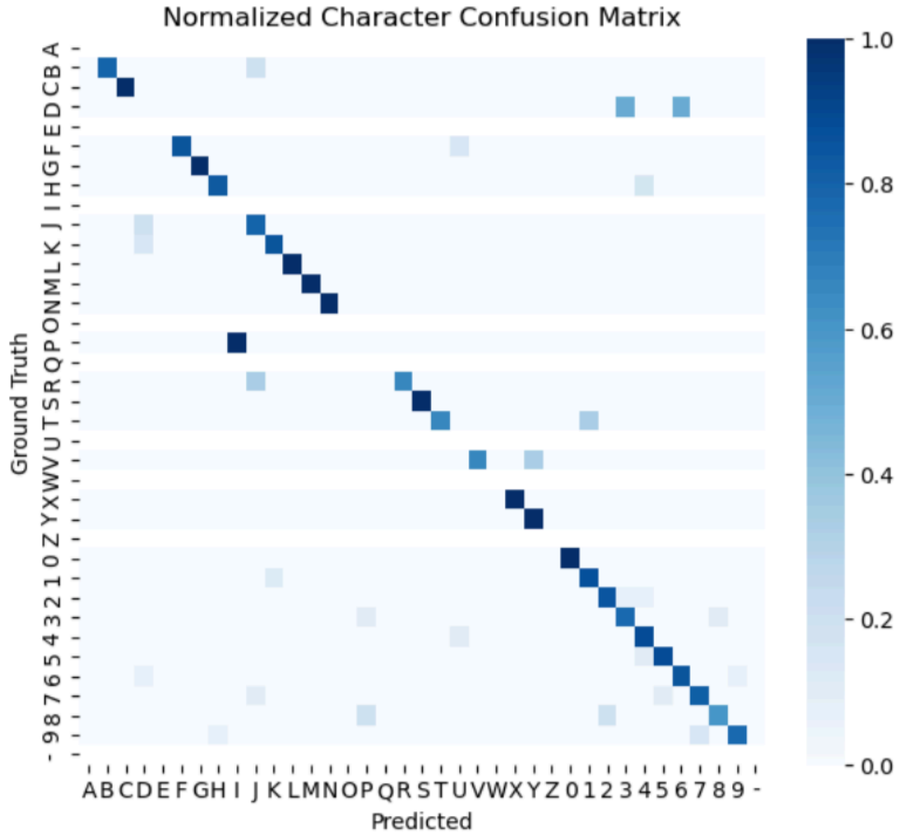
Accuracy: check if prediction is exactly equal to GT

Normalized Levenshtein Similarity: edit distance between prediction and GT

Subset	Accuracy	NLS	Avg. Confidence	Character F1 score
Test set	**0.57**	**0.83**	**83%**	**0.84**

Frontal	0.86	0.98	94%	0.97
Lateral	0.70	0.95	93%	0.90

Recognition and Final Results



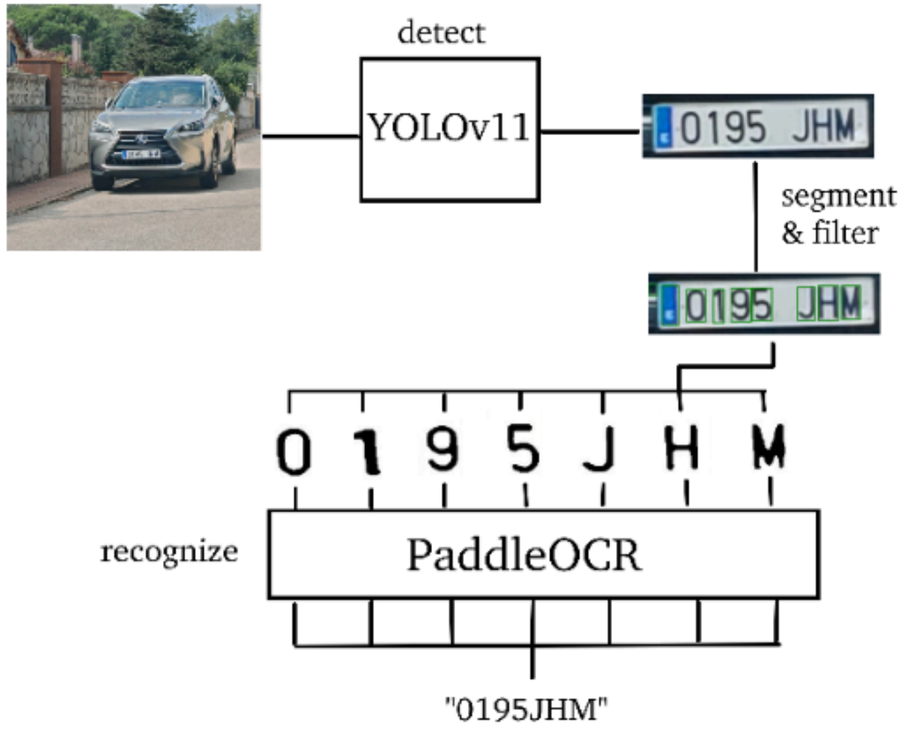
Recognition and Final Results

2956MJG

6005KFV

481G1T 0.91%

Conclusions & Things to improve



Pipeline needs few improvements as accuracy is subpar although F1 score explains it.

IMPROVEMENTS:

- Improve the dataset with more images, although augmentation was present it was not sufficient.
- The current image preprocessing pipeline could be improved by applying light correction only in specific cases like low visibility, rather than pre-processing all images.
- K-fold cross-validation should be applied in future evaluations once the dataset grows larger to avoid bias from using a single test subset.