CARISSMA
Automotive Safety Research

European Union Dataset and Annotation Tool for Real Time Automatic License Plate Detection and Blurring

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Motivation

- National data protection law that came into force in May 2018 in Europe
  - All personal items that can be used for identification must be anonymized in captured data
  - In Europe, license plate number can be used for identification
- A tool to automatically blur license plates in image data will be necessary
- Existing open source license plate detectors are restrictive in nature. Most require the camera to be stationary, only detect license plates at a certain angle or only work under restricted lighting conditions
- Existing open source license plate datasets have limited number of unique images or variation of angles and distances

Aim

1. Create a European Union License Plate Dataset
    - Include images taken under day, night and snowing conditions
    - Images should capture various angles and distances of license plates
    - Enough labelled images to train a robust license plate detector
2. Train a license plate detector by machine learning using our dataset
    - Works under non-restrictive environment
    - > 90% accuracy

Data Acquisition

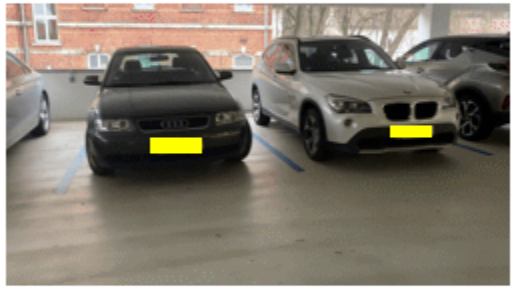
1. Took video sequences of vehicles on roads and in car parking places in Germany and France
    - Videos were taken with an iPhone XS MAX and an ASUS Zenfone
    - 30 fps
    - 1,980 x 1,020 HD resolution
2. Extracted images from the videos. 1 image from every 10 frames were extracted to avoid images being too similar to each other
3. Manually Labelled all the license plates in the images using the “FastLable” labelling tool to form the THI License Plate Dataset (TLPD)
4. Used Yolo v3 detector to detect for cars, motorcycles, buses and trucks in the images. If at least one license plate is present in the detected vehicle area, it was saved as an image for the cropped image set

Dataset description

- The dataset includes an HD image set (1,980 x 1,020 HD images) and a cropped image set (Vehicle images detected by Yolo v3 detector)

	HD image set		Cropped image set	
	Images	Labels	Images	Labels
Day	3,412 (56%)	8,534 (62%)	11,050 (64%)	11,899 (63%)
Night	1,674 (28%)	2,940 (21%)	3,348 (20%)	3,685 (20%)
Snow	1,002 (16%)	2,287 (17%)	2,707 (16%)	3,088 (17%)
Total	6,088 (100%)	13,761 (100%)	17,105 (100%)	18,672 (100%)

Dataset description

Day images	Night images	Snow images	Motorcycle images
			
			
			

Training the License Plate Detectors

- Two license plate detectors were trained using TLPD cropped image set.
- The dataset was divided into 60% for training, 15% for validation and 25% for testing.
    - To avoid bias, only images from different video sequences were used for training, validation and testing data.
- Both detectors were trained with transfer learning and fine tuning.

Architecture	Fast-Yolo	Tiny-Yolo v3
Initial weights	UFPR LP detector [1]	Tiny-Yolo v3 detector [2]
Batch size	128	512
Image size	416 x 416	608 x 608
Learning rate	0.0001	0.001
No. of epochs	30,000	30,000

1. R. Laroca, E. Severo, L. A. Zanlorensi, L. S. Oliveira, G. R. Gonc¸alves, W. R. Schwartz, and D. Menotti, “A robust real-time automatic license plate recognition based on the yolo detector,” in 2018 International Joint Conference on Neural Networks (IJCNN), pp. 1–10, IEEE, 2018.

2. J. Redmon and A. Farhadi, “Yolov3: An incremental improvement,” arXiv preprint arXiv:1804.02767, 2018.

Results

Overall performance:

	Precision (50% IoU)	Recall (50% IoU)
Fast-Yolo detector	90.08%	90.11%
Tiny-Yolo v3 detector	91.44%	92.32%

Performance of Tiny-Yolo v3 detector under different lighting / weather conditions:

	Precision (50% IoU)	Recall (50% IoU)
Day	92.74%	93.17%
Night	93.84%	93.94%
Snow	86.97%	87.65%

Conclusion

- THI License Plate Dataset, one of the largest open source European Union license plate dataset
- TLPD and “FastLabel” labelling tool can be downloaded at www.thi.de/go/license-plate-detection
- Two license plate detectors that work in real-time and under non-restrictive environment with an overall accuracy higher than 90%

Future work

- Include more images taken under different weather conditions, such as foggy and heavy rain into our dataset
- Include labels that reflect the orientation of the license plates (4 corners of the LP)
- Discover the possibility of using the orientation and size of the detected license plate to estimate the orientation and distance of the target vehicle

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