Vehicle Make & Model recognition

V3C

Abstract

The aim of this project is the ability to recognize category, make and model of vehicles from portals cameras. The developed software recognizes the attributes in both directions: the incoming vehicles, where all attributes (category, make, model) are recognized, and outcoming vehicles, where category and make only are recognized. The system employs a state-of-the-art recognition algorithms based on deep convolutional neural networks and is able to recognize thousands vehicle models with superhuman accuracy.

Abstrakt

Cílem projektu je rozpoznání kategorie, výrobce a modelu vozidla z kamer umístěných nad vozovkou. Vyvinutý software rozpoznává příslušné atributy pro oba směry vozidla. Pro přijíždějící vozidlo je schopen určit kategorii, výrobce a model, pro odjíždějící vozy pak kategorii a výrobce. Systém využívá nejmodernějšího rozpoznávacího algoritmu založeného na hlubokých konvolučních neuronových sítích. Systém je schopný rozpoznat tisíce modelů vozidel a svojí přesností překonává lidské rozpoznávací schopnosti.

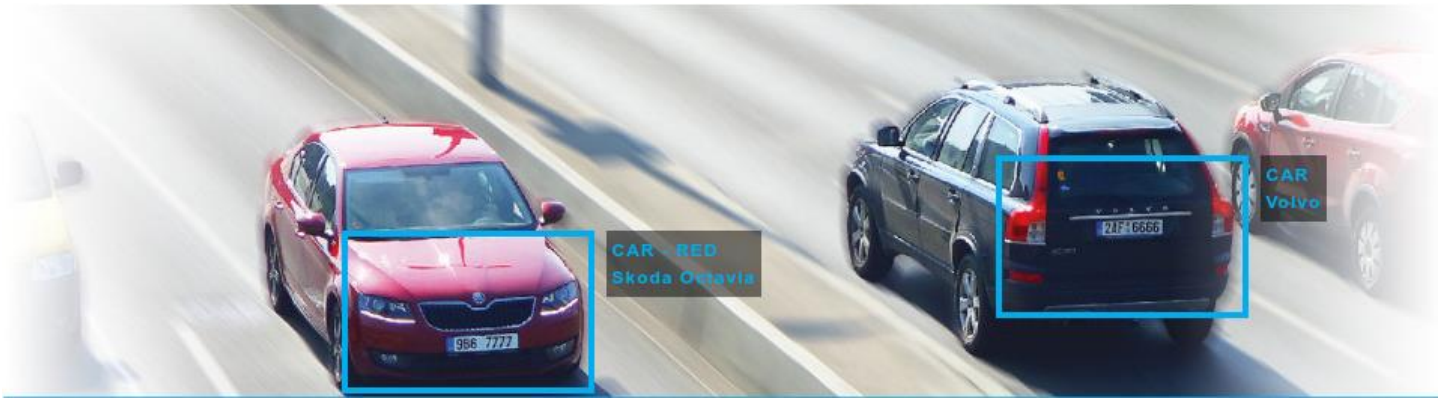


Figure 1: Vehicle MMR of incoming and outcoming vehicles.

Traffic data collection and their analysis is essential for urban traffic flow regularization and optimization. Eyedea's MMR recognition software plays a key role in obtaining vehicles attributes. The MMR software is instrumental not only for data statistics systems but also for enforcement systems, where different rules apply for different types of vehicles such as speed limits or prohibited zones. The MMR software is also used in surveillance systems where it facilitates searching for a vehicle of interest.

Eyedea's MMR software can work in several modes: the category recognition only, category - make recognition or category-make-model recognition. The recognized vehicle categories include CAR (personal cars, cabriolets, SUV), VAN (like Ford-Transit, VW-Transporter etc., total weight up to 3.5t), LGT (light trucks), HVT (heavy trucks), BUS, and MTB (motorbike). The categories are defined per make-model pairs (e.g. Ford-Transit is VAN), and thus can be easily reconfigured according to customer requirements. The model attribute is a name of a family of a particular vehicle such as the model VW-Golf, which covers all its modifications (e.g. GTI, Sporstvan, Variant), and also all its generations.

Our Technology

Our system is based on the image pattern recognition using deep convolutional neural networks. The position and dimensions of a classified pattern are estimated from a localized license plate. The license plate serves not only for the vehicle localization but also for the calibration of dimensions. Examples of classified patterns are shown in Figure 1. Highlighted by blue rectangles.

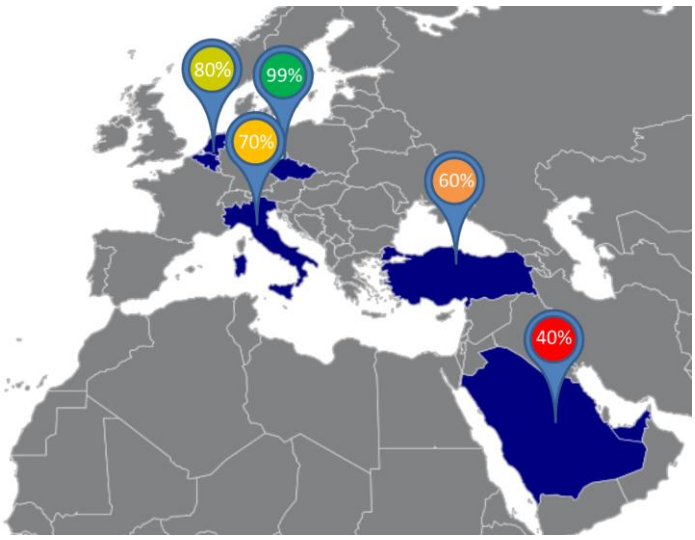
The recognition network is trained on millions of training examples. Collection and annotation of training data is long-term and systematic work that we have been doing in Eyedea for many years. Moreover, 5-10% of old vehicles are replaced by new models every ear. To keep the MMR system up to date, continuous vehicle model adding and classifier retraining is necessary. Reaching the

ultimate recognition accuracy Eyedea's training data are covering over a hundred of makes and hundreds of models. Although customers require only the model name, vehicles are internally categorized more thoroughly into model-variations where the variation distinguishes model generations and facelifts. Such categorization goes up to thousands of make-model-variations classes.

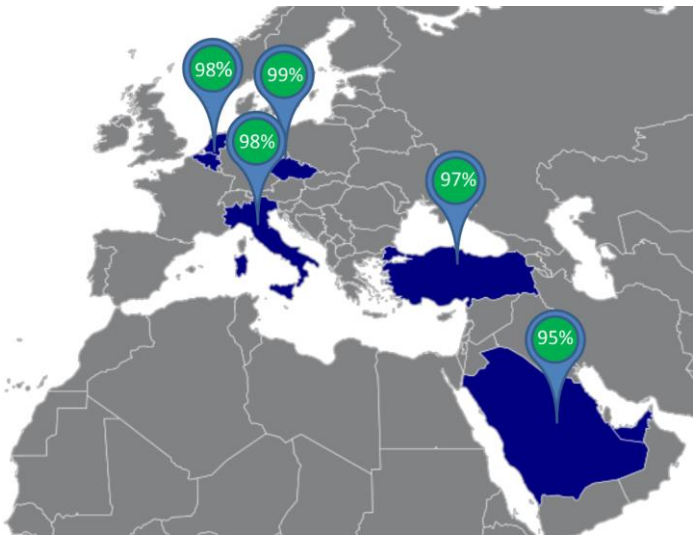
Achievements & Challenges

The Eyedea's MMR software reaches over 99% accuracy on Make-Model recognition task for regions where the training data come from. The make distribution over the given region plays a big role in the total recognition accuracy. For example, only 1-2% of vehicles in the Czech Republic are Fiats, but it dominates in Italy and vice versa with the Škoda make.

Recently Eyedea was facing new challenges to recognize vehicles in regions far away from the Central Europe, where distributions of vehicle makes and models are completely different and where a significant number of vehicles are of a make without the car distribution in Europe. Figure 2 a) shows how the software initially trained on the Czech data worked when it was used in other regions. Figure 2 b) shows updated recognition accuracy after adapting system to local vehicle makes and models. Such success can only be achieved in cooperation with customers and through the hard work on data preparation. We at Eyedea are proud of it.



a) Recognition accuracy of the software trained on CZ data only



b) Recognition accuracy of the software after the update.

Figure 2: Make-Model classification accuracy before and after adapting the software to local vehicle types.

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Centra kompetence

Acknowledgment

This work was supported by the Technology Agency of the Czech Republic.