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БОЛЬШАЯ ТРОЙКА

Analysis of data on garbage containers occupancy for the creation of electronic services in the field of solid waste management

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Background

One of Big3 company main projects is developing an Automated Management System, a data collection and analysis system for waste management applications. It automatically keeps track of waste at sites, creates and optimises routes, sets waste transport targets and monitors their execution in real-time.

Objectives

Each waste collection vehicle driver has access to a specific app to upload photos of the collection site before and after emptying the containers. For quality control, the analytical system should use a pair of these photos to determine whether or not the waste has actually been removed at that particular site.

Process

To solve such a problem, deep learning methods were applied. The dataset consisted of thousands of 'before/after' photos for different waste sites in various shooting conditions and times of day; a few examples are shown in Figure 1. The main goal was to improve the base model performance and to correct its shortcomings; besides, it was decided to rebuild the whole training and validation pipeline using a different deep learning framework. A series of experiments with various neural network architectures, hyperparameters and training parameters were conducted to maximise the model's accuracy (some of the intermediate results are shown in Table 2). The best model was chosen based on the maximum value of the quality metric and taking into account the model size restrictions.

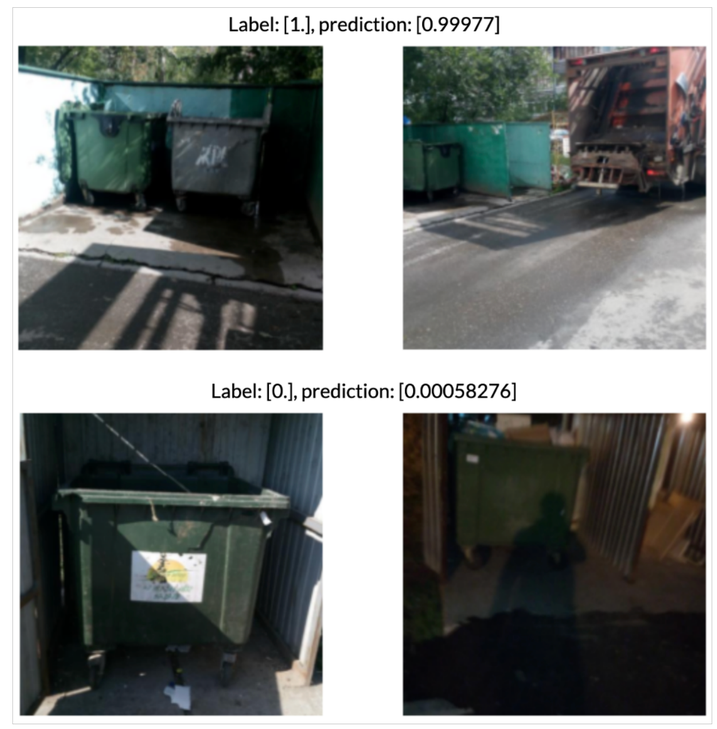

Figure 1. Examples from the test set with ground truth labels and the model's predictions

Experiment name	Eval strategy	Accuracy	Size, MB
mobilenet2_512_256_convs	v 1.0	0.70515	70
mobilenet2_512_1024_convs	v 1.0	0.9587	135
mobilenet2_avgpool_1_fc	v 1.0	0.70144	9
mobilenet2_avgpool_2_fc	v 1.0	0.94607	19
mobilenet2_avgpool_2_fc_dout	v 1.0	0.94648	19
mobilenet2_avgpool_2_fc_dout_2	v 1.0	0.94359	19
mobilenet2_avgpool_2_fc_dout_2_0.4	v 1.0	0.94772	19
mobilenet2_avgpool_2_fc_dout_2_0.5	v 1.0	0.9426	19
mobilenet3_1	v 1.0	0.96407	21
mobilenet3_2	v 2.0	0.9499	21
mobilenet3_3	v 2.0	0.96751	21

Table 2. Intermediate results for a series of experiments to determine a suitable model architecture

Results

The following results were achieved during the internship:

- Fixed accuracy validation method that caused previous measurements to be not entirely correct due to data leakage
- Migration from one neural network framework (TensorFlow) to another (Pytorch)
- Downsizing the final model by a factor of three
- Increased model accuracy from ~91% to 96.6%

Conclusions

Thank you to Andrey Pimenov and Professor Igor Uzhinsky for making this internship possible. Thank you to Big3 for the excellent opportunity to apply my skills and learn more about the waste management field. Thank you to Sergey Hohlov for the warm welcome from the company. And finally, thank you to Evgeny Benzak, who was always available to answer any technical questions I had.

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