Detection of prohibited baggage objects based on computer vision methods

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Introduction

One of the critical tasks in which there are the highest requirements for the quality of the solution is the inspection of luggage of people in crowded places. In particular, with the help of special scanners, X-ray images of passengers' luggage at the airport are obtained. Based on such images, the operator manually decides on the presence or absence of prohibited items. In case of fatigue, loss of concentration, deterioration of vision, the operator is prone to errors. Automated computer vision systems can be used to assist in decision making. The article discusses an approach to processing X-ray images of luggage based on the transfer learning of the YOLO neural network. It is shown that after pruning the model, it is possible to accelerate the model without significant loss of quality. In terms of the F1-score metric, we managed to achieve 86% with 50% confidence. Testing the model on new data showed the good quality of the developed solution.

Training and Inference

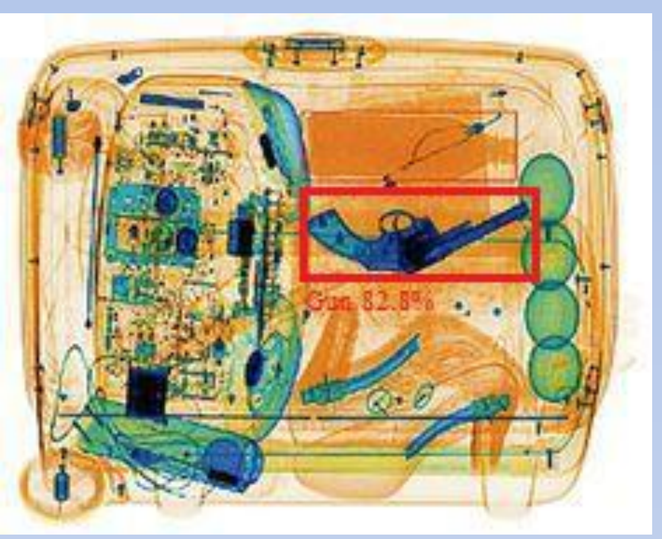

Fig. 1. Detection Example

A total of 100 images were collected, in which the appearance of firearms along with other objects was simulated 52 times. The training sample was 80% of the original. On which objects of prohibited classes were presented on 41 images. The remaining 20 images with 11 prohibited items were used as a test sample.The labeled data contained information about the class of the detected object (there was only one class “Gun”) and its location in the image, i.e. bounding box coordinates.All images were scaled to 200 by 200 pixels. Then normalization was performed. All color channels were used.

Results

Table 1. Detection Efficiency

Model	mAP	mAR	F1-score
YOLO	0.90	0.818	0.857
YOLO + Pruning	0.75	0.818	0.783

Table 2. Detection Performance

Model	FPS
YOLO	3,82
YOLO + Pruning	6,31

Conclusions

For the actual task of detecting prohibited items from luggage images, a solution was developed using the YOLOv3 convolutional neural network. It was possible to achieve a completeness of detection at the level of 82%. The use of pruning weights does not lead to losses in completeness, however, it reduces the accuracy of the model. At the same time, after pruning, the processing speed increases by more than 1.5 times. In the future, research is planned based on the new generation YOLO models, as well as additional methods to optimize the performance of the detector. Since the initial sample size was quite small, it is planned to perform data augmentation in future studies.

Fig. 2. Processing Examples

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