Anonymization techniques on photos and video streams

Poster summarizing the final thesis for the
academic degree Master of Science (M.Sc.) by
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Motivation

Image and video data are likely to contain personally identifiable information (PII) according to the European General Data Protection Regulation and as such need to be treated with the appropriate technical measures to protect that information. While for structured data the processor of that data predefines what type of data with which level of privacy will be stored and to whom it will be made available, for unstructured data it is a whole different story.

> *"The protection of natural persons in relation to the processing of personal data is a fundamental right."*
> Article 1, General Data Protection Regulation

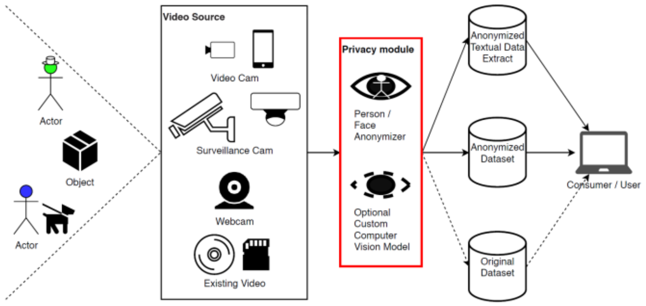
Over the last years, automated re-identification (Re-ID) of persons in videos has been advanced rapidly, which leads to a strong need for privacy measures on video and image data. So even image and video data not primarily recorded for that purpose may be reused for Re-ID. This work shows that it is possible to shift PII data from being an unavoidable by-product of video recording to either be a controlled side-product or be completely removed.

> *"It also doesn't matter how the data is stored – in an IT system, through **video surveillance**, or on paper; in all cases, personal data is subject to the protection requirements set out in the GDPR."*
> European Commission on: What is personal data?

Realization

Different deep learning approaches to human sight such as classification, object detection, and human keypoint detection are introduced and progress in those fields of research is presented. Mathematical definitions for the performance measures used for model evaluation are introduced and their respective interpretation is discussed.

Context Diagram of the developed Anonymization Module



Two showcases and two use-cases in different problem domains and their benefit from visual anonymization are explained. The showcase Person counting is representative for a regression problem. The use-case visual object tracking in industrial environments represents a classical object detection problem. Both, the showcase Age, sex and emotion estimation with video anonymization and the use-case Emotion detection of deboarding passengers are examples for conditional facial anonymization, where some attributes of the original persons on the image are supposed to be retained even after anonymization.

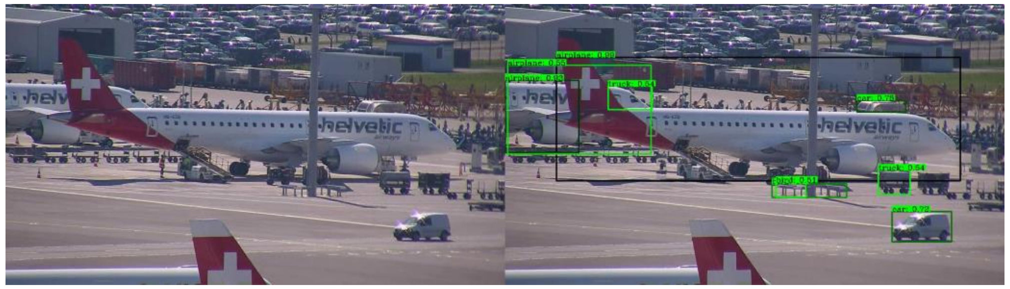
Results

The applicable concepts of anonymization frameworks for textual data are transferred to visual data. Multiple object detection algorithms like OpenCVs Histogram oriented Gradient person detector, Faster R-CNN, Mask R-CNN, Single Shot Detectors, and CenterNet are evaluated with respect to model performance and inference speed. CenterNet is selected as the default model showing a good tradeoff between inference speed and model performance. Based on these results a modular, near real-time framework for anonymization using state of the art object detection algorithms is developed in this work.

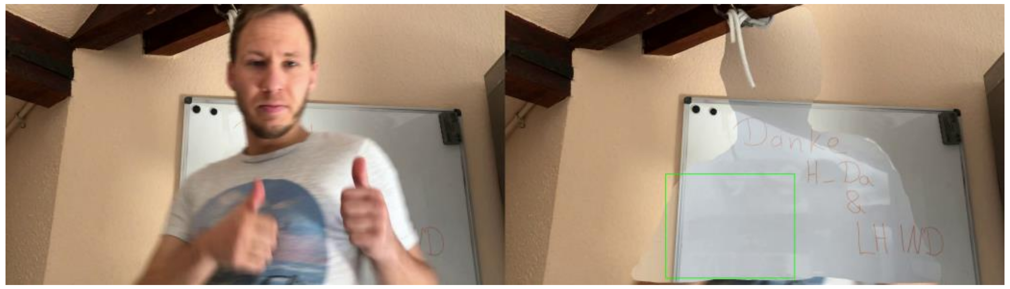
Performance Measurements for different Models

Model	FPS ↑	ms/it ↓	IoU pB ↑	IoU pC ↑	RMSE ↓
Null Model	71.26	14	0.00	0.00	15.99
Perfect Model black*	106.44	9	1.00	1.00	0.00
Perfect Model	94.78	10	1.00	1.00	0.00
OpenCV HOG People Detector	1.72	581	0.02	0.02	2.34
Mask R-CNN	5.97	167	0.53	0.58	0.85
Faster R-CNN	7.74	129	0.51	0.56	0.86
Faster R-CNN + MOSSE Tracker 10	29.03	34	0.46	0.51	0.88
SSD	8.01	125	0.32	0.24	1.43
CenterNet	21.92	46	0.49	0.51	0.96
Faster R-CNN Jetson	0.35	2857	0.51	0.56	0.86
SSD Jetson	7.43	135	0.22	0.22	1.41

Anonymization followed by object detection at Airport Zurich, Input left and Output right



Anonymization with replacement by median pixel on webcam, Input left and Output right



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