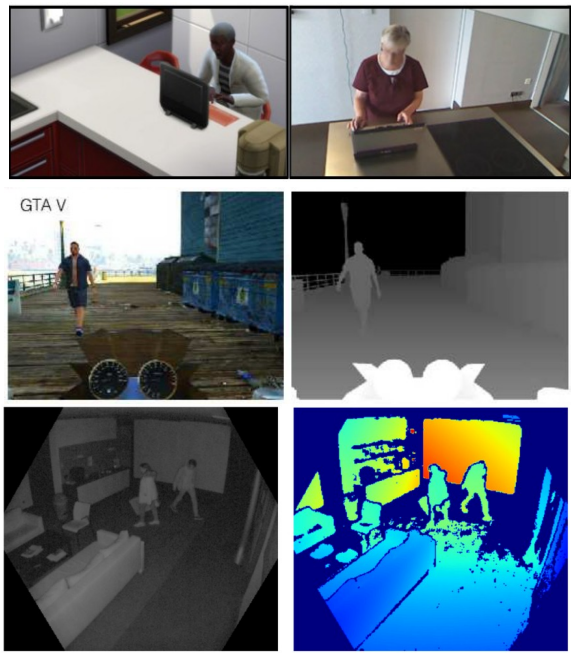
German Research Center for Artificial Intelligence
Research Department Augmented Vision

Master Thesis Proposal
Domain Adaptation for Depth-based Video Anomaly Detection with Synthetic Data from Video Games

Modern machine learning-based computer vision techniques often rely on large amounts of data for training, which can pose a challenge in situations where recording and annotating data is a time-consuming process. Simulations are a possible way to approach this problem by generating synthetic data. However, developing a dedicated simulation for each specific application is costly. Modern commercial video games can offer versatile virtual environments, which allow simulations for many different applications to be run within them. The auxiliary data created by the games in order to render scenes and run game mechanics can moreover provide precise ground truth for training and evaluation of computer vision methods.
In this thesis, a video game-based simulation will be used to create a dataset of synthetic depth videos that feature normal and anomalous human behavior. Depth information is provided by the depth buffer of the game's graphics pipeline. The target domain for adaptation are real depth recordings captured using a *Microsoft Azure Kinect* time-of-flight camera. Using the synthetic data, a deep learning-based anomaly detection algorithm can be trained. The main goal of the thesis is to use domain adaptation techniques in order to optimize the performance on real data while training on synthetic data.



Tasks

- Literature review of (visual) domain adaptation and use of video game-based simulations in computer vision research
- Choosing an appropriate video game and creating a dataset of synthetic depth videos for anomaly detection
- Development of an unsupervised domain adaptation method to optimize performance of anomaly detection on real data

Requirements

- Basic understanding of the computer graphics pipeline
- Python programming
- Experience with at least one deep learning framework (*TensorFlow, PyTorch, Keras*)

References

- *RenderDoc:* https://renderdoc.org/ *ReShade:* https://github.com/crosire/reshade
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- Richter, Stephan R., et al. "Playing for data: Ground truth from computer games." *ECCV*. Springer, Cham, 2016.
- Schneider, Pascal, et al. "TIMo – A Dataset for Indoor Building Monitoring with a Time-of-Flight Camera." *arXiv preprint arXiv:2108.12196* (2021).
- Katrolia, Jigyasa, et al. "An Adversarial Training based Framework for Depth Domain Adaptation." *VISIGRAPP* (4: VISAPP). 2021.
- Wang, Mei, and Weihong Deng. "Deep visual domain adaptation: A survey." *Neurocomputing* 312 (2018): 135-153.
- Pang, Guansong, et al. "Deep learning for anomaly detection: A review." ACM Computing Surveys (CSUR) 54.2 (2021): 1-38.

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