Augmentation of images with generative networks

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KI DATA TOOLING
The Data Kit for Automotive AI

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Need for diverse data in automated driving

Automated driving functions rely on the diversity of training data. An example of underrepresented data are images of rarely occurring traffic signs or rare weather conditions. However, it is costly to record various data in real-world test drives. As an alternative to the real-world data recording, we propose augmentation based on Generative Adversarial Networks. This way the missing data points can be created synthetically without the need of further elaborated real-world data recordings.

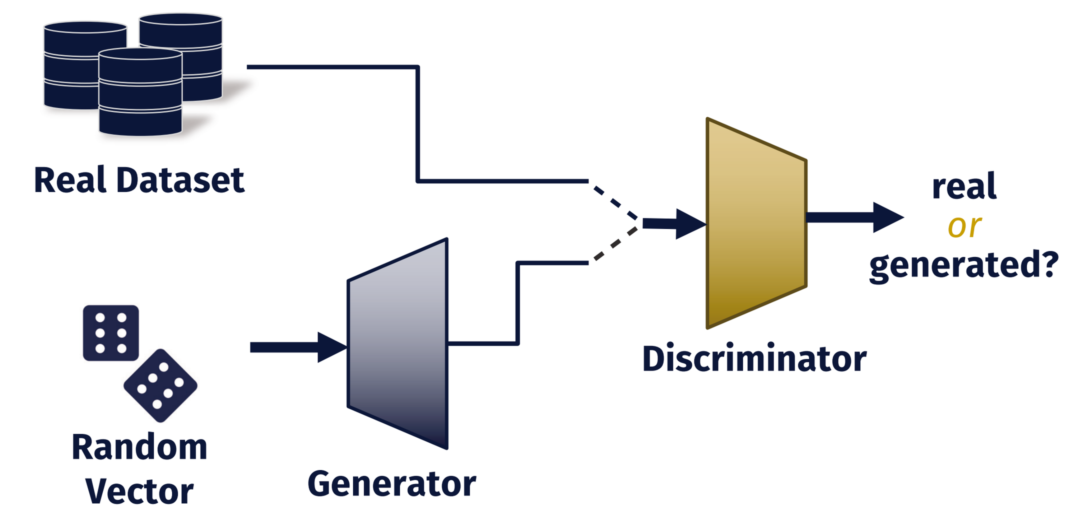

Figure 1: Generative Adversarial Network training architecture [2]

Generative Adversarial Networks (GANs)

During the training process of a GAN, the network learns the underlying data distribution. This is done by the counterparts generator and discriminator. The discriminator learns to distinguish real and generated images. After training, the generator is able to generate new images that looks like they originate from the same underlying distribution as the training data. During the inference, this property is used to generate new examples, which can be used for the training of automated driving functions.

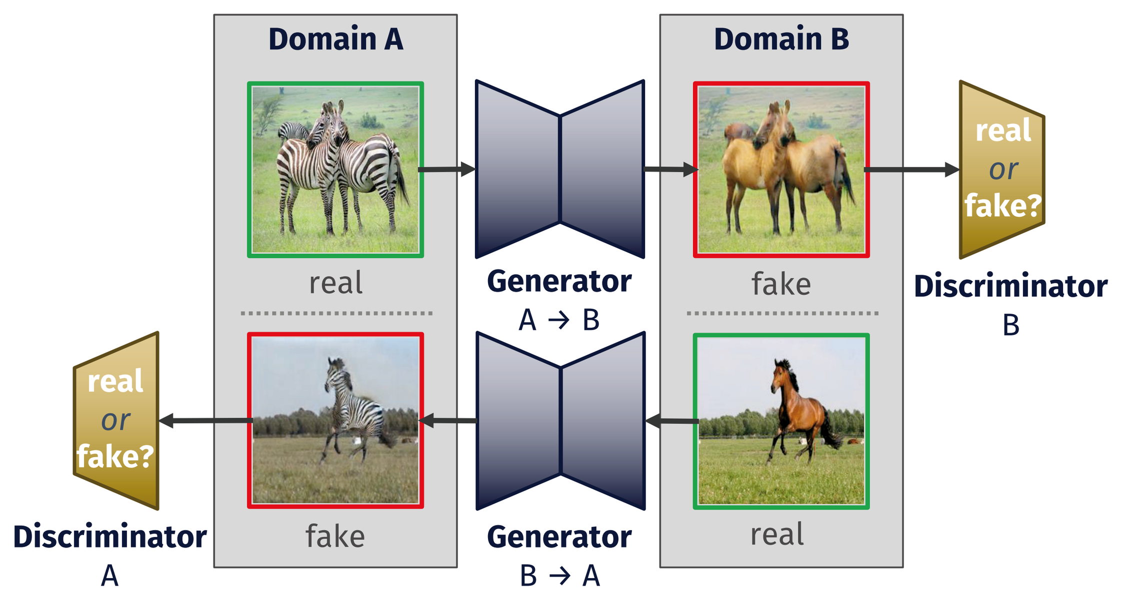

Figure 2: Example of an image-to-image transformation GAN: CycleGAN [3]

Image-to-Image Transformation

There are special GAN architectures for image-to-image transformations. These architectures are able to transform images between different domains. For example the generator of a CycleGAN [3] learns how to transform an image from one domain to an other domain.

One environmental property which cannot be influenced or can only be influenced to a limited extent during recording is the weather. This is especially challenging because some weather situations occur rarely in some areas.

To tackle this problem, we first need to know the weather in every image of the data set. Therefore, we label a part of the data set and annotate the rest by training a network to detect the weather in the images automatically. Afterwards an image-to-image architecture is trained where each domain represents one weather situation.

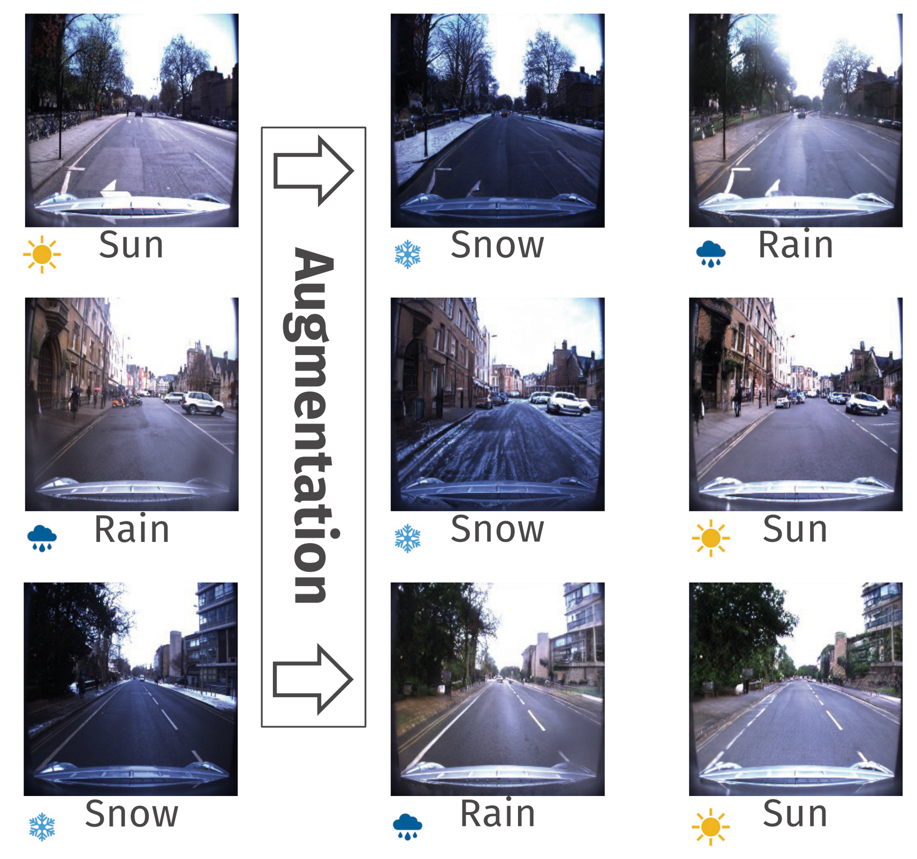

Figure 3: Exemplary augmentations of the Oxford dataset [4] with a image-to-image GAN architecture[1]

References:

[1] Rigoll, Philipp, et al. "Augmentation von Kameradaten mit Generative Adversarial Networks (GANs) zur Absicherung automatisierter Fahrfunktionen." Fahrerassistenzsysteme und automatisiertes Fahren, VDI Verlag, (2022): 41–48.
[2] Goodfellow, Ian, et al. "Generative adversarial nets." Advances in neural information processing systems 27 (2014).
[3] Zhu, Jun-Yan, et al. "Unpaired image-to-image translation using cycle-consistent adversarial networks." Proceedings of the IEEE international conference on computer vision. 2017.
[4] Maddern, Will, et al. "1 year, 1000 km: The oxford robotcar dataset." The International Journal of Robotics Research 36.1 (2017): 3-15.

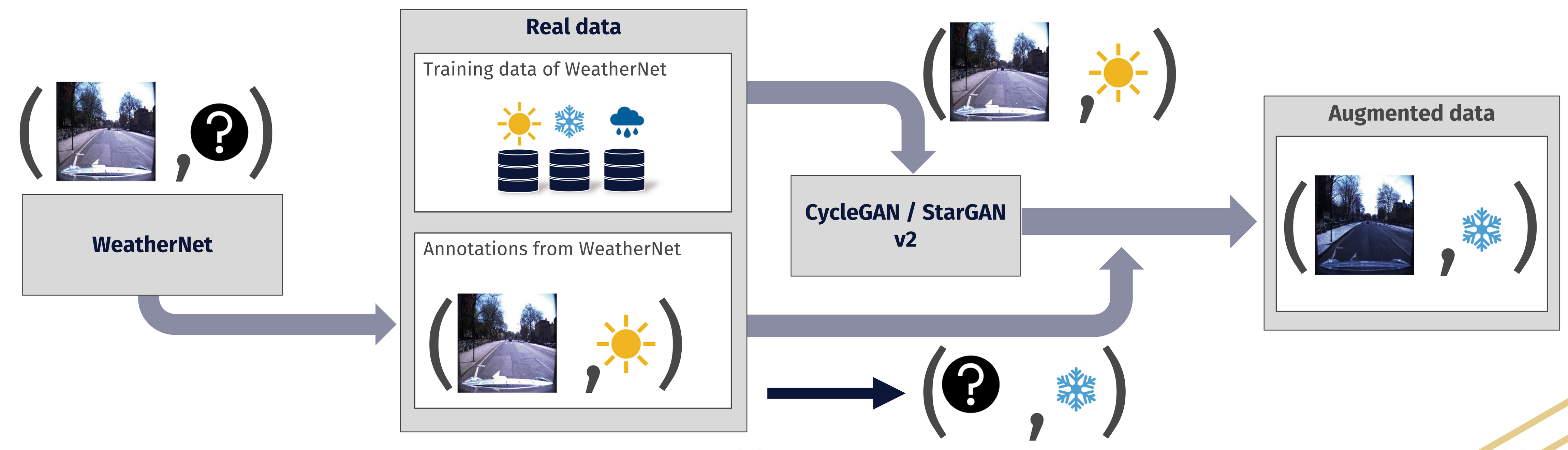

Figure 4: Overview: process where the weather of the Oxford data set [4] is annotated and the data set is augmented with weather situations [1]

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