Reliability of GAN Generated Data to Train and Validate Perception Systems for Autonomous Vehicles (Supplementary Material)

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1. Steps to generate high resolution images

We used different techniques to increase the quality of generated night images as shown in Figure 1. We first trained the cycle-GAN model from scratch using just our dataset with 1800 day/night images. The first night image is generated using downsampled real day image. As shown in the top left figure, the image is blurry and the color is not accurate. Then, we applied transfer learning technique where the model initialized with pre-trained weights and fine-tuned on our data. As shown in the top right figure, the image is darker which looks more like real night images. However, the details are lost as well. After using full resolution input real day images for inference, more details are preserved. At last, we use random cropped patches during training to keep more local features. The generated images look sharp with better color clarity as shown in the bottom left figure.

2. Improving object detection performance using GAN data for training

With GAN generated night images for training, the overall mAP values on real night test data are improved. Along with the quantitative results in the main paper, we would also like to point out qualitative improvements here. It is worth pointing out that there are no motorbike objects in real night training set. Thus, some motorbikes in night time test data cannot be detected if the model is only trained with real day and real night images. However, the model can fix it when we introduced GAN night images where some features for such objects at night are crucial for the detection model. As shown in the Figure 2, the model can now detect motorbike that was not possible previously without the help of GAN night images.

Table 1. Number of objects in real day training data and real night trainnig data

Number of Objs	Real Day Train	Real Night Train
Car	24702	1021
Big Vehicle	4811	63
Motobike	58	0

*This work was done during Weihuang Xu's internship at the Volkswagen Group Innovation Center California

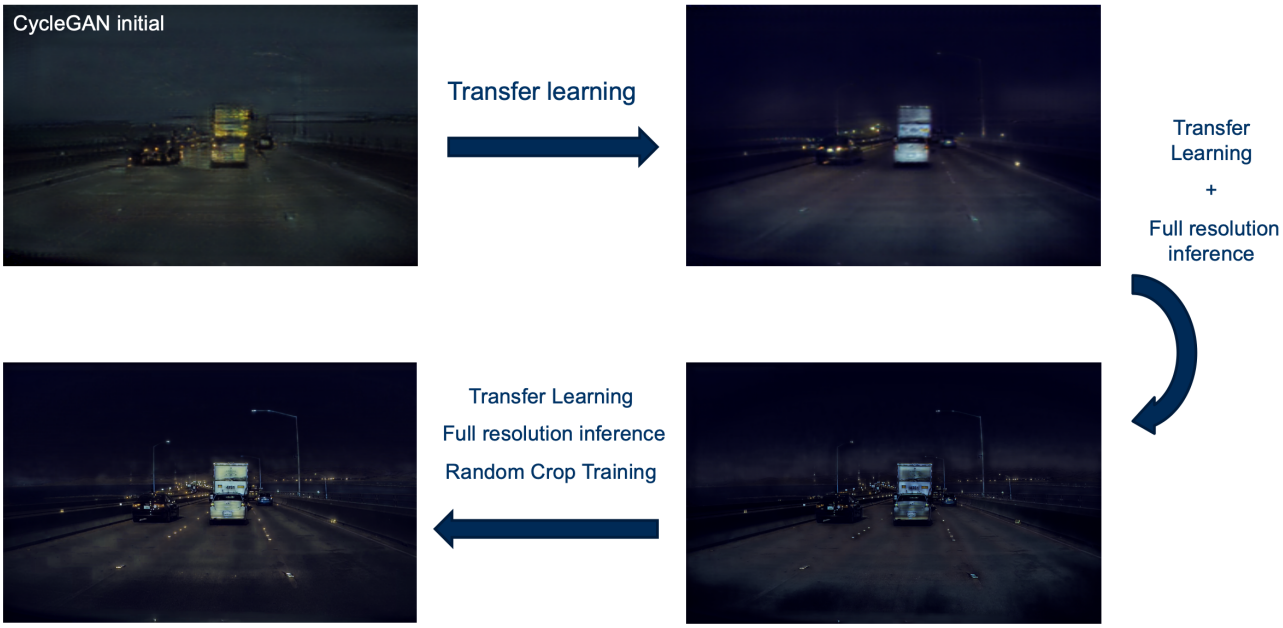

Figure 1. Images generated by Cycle-GAN with different techniques.

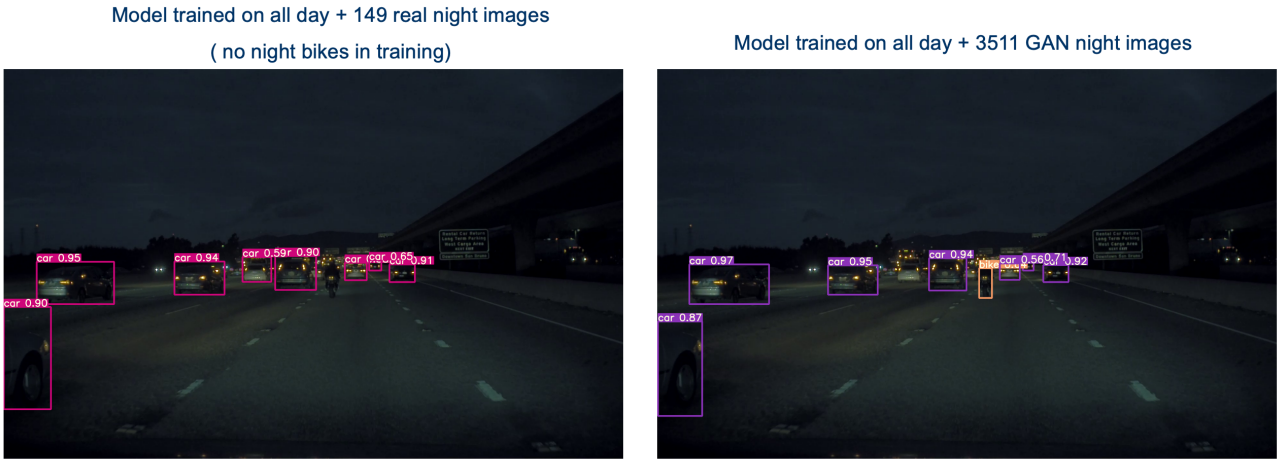

Figure 2. Examples of motobike detection in real night images.