Supplementary Material: Supervised and Unsupervised Learning of Parameterized Color Enhancement

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1. Supervised model network architecture

Figure 1 presents the architecture of our generator for the paired model.

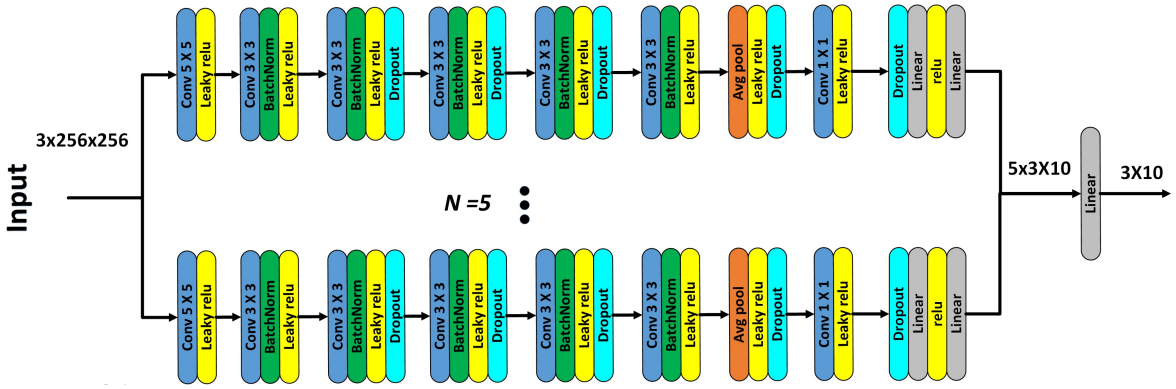


Figure 1. The multi-branch network architecture of the paired case. All convolution layers are with stride two except the last one.

2. Unsupervised model network architecture

Figure 2 describes both the generator and the discriminator architectures used in our unpaired model.

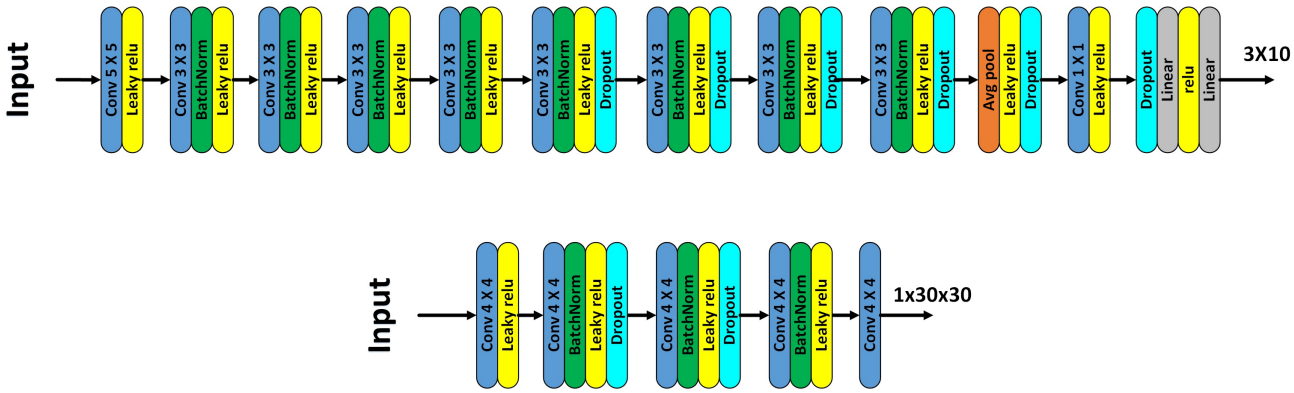


Figure 2. Network architecture for unpaired training. Top: our generator; Bottom: our discriminator. For the generator, all convolution layers are with stride two, except the last one. For the discriminator, all convolution layers are with stride 2.

3. More comparisons on the MIT-Adobe FiveK dataset

Figures 3 show examples of our method, in both the paired and unpaired training scenarios, compared with expert C and the leading enhancement methods available.

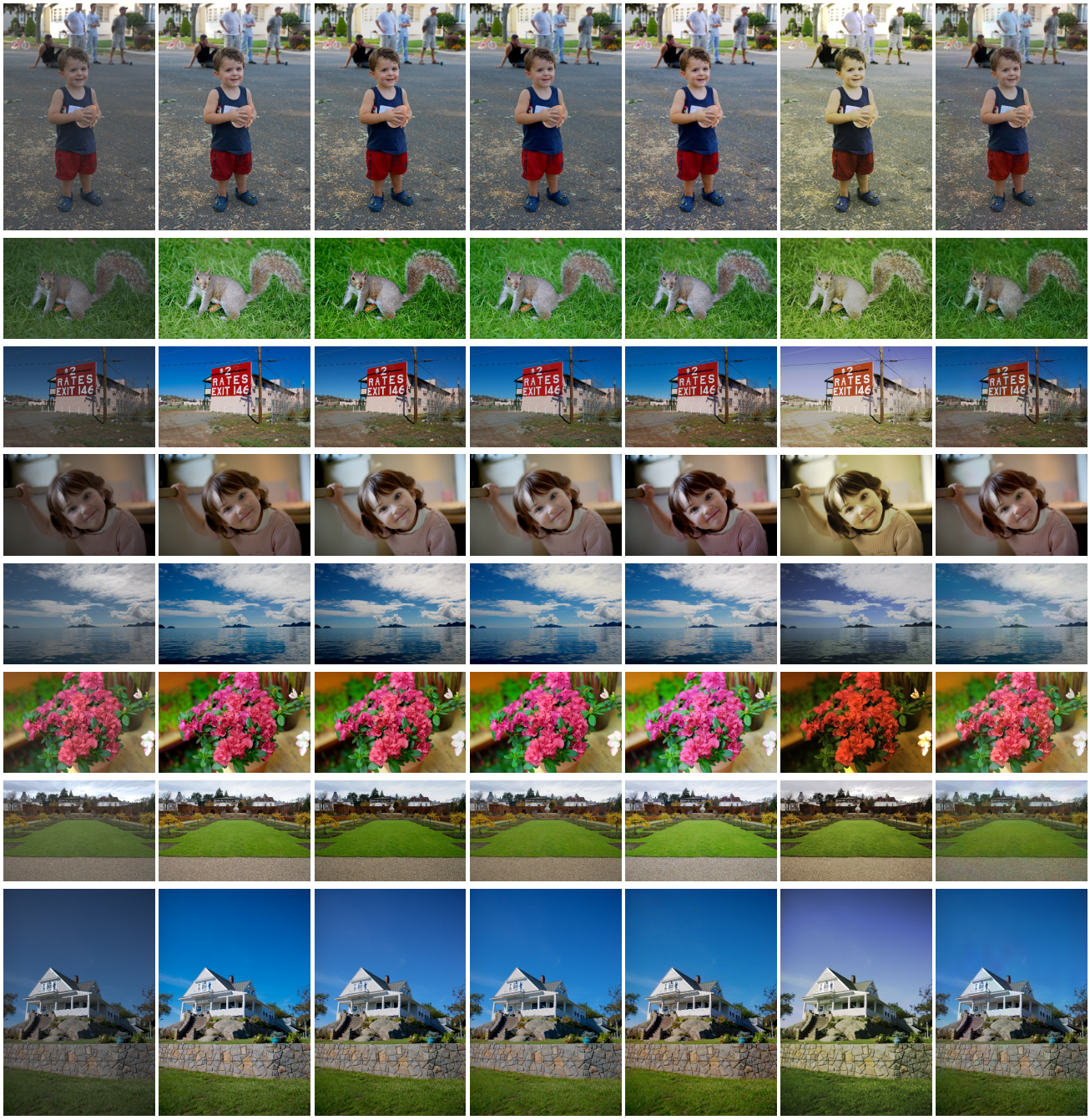
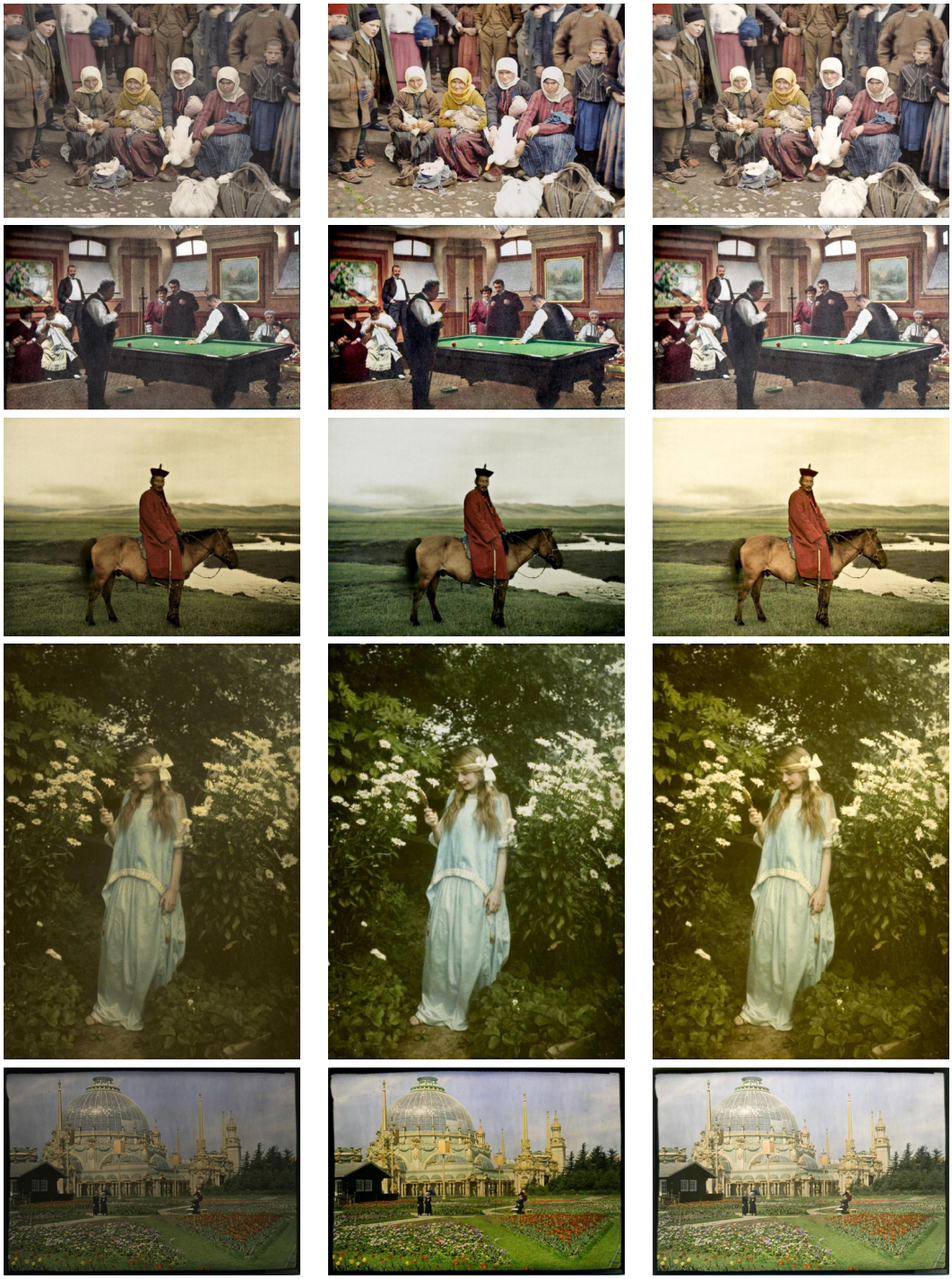


Figure 3. Qualitative comparison of our methods with [1, 3, 2] and the expert on MIT-Adobe FiveK.

4. Comparisons on color photos from the early 20th century

Figure 4 shows results of Adobe Lightroom, a leading commercial software using Auto-Tune feature and our paired model enhancing color photos from the early 20th collected from the Internet.



input ours - paired Adobe Lightroom

Figure 4. A comparison of our paired method to Adobe Lightroom on a set of color photos from the early 20th century.

5. Comparisons on game of thrones

We show results in Figure 5 of Adobe Lightroom using Auto-Tune feature and our paired model enhancing images taken from the “the dark episode” of game of thrones. We also enhanced video scenes and attached it as supplementary material comparing both methods side by side. Each frame is processed independently without notable temporal flick.

Figure 5. A comparison of our paired model to Adobe Lightroom on a set of frames from the Game of Thrones dark episode. The methods were applied as-is without any modification.

6. Model Limitation

Figure 6 provides failure cases of our unpaired model. One failure case of our unsupervised learning scheme is producing images with the wrong white balance. White balance is the process of removing unrealistic color casts, so that objects which appear as white to a person are rendered white in the photo. White balance has to take into account the ”color temperature” of a light source, which refers to the relative warmth or coolness of a white light in the scene. Performing white balance may require a semantic understanding of the scene and learning this procedure through unsupervised learning can suffer from the existence of inherent ambiguity.

Though our paired model may also provide poor white balancing, it is far less frequent in its case.

Another limitation of our unpaired model is that it may produce nature scenes, which are less colorful compared to the expert retouching.

input ours - unpaired expert

Figure 6. Failure case of our unpaired method. The top two rows present failures that are due to poor white balancing, and the lower two rows are nature scenes which are not as colorful as the expert results.

References

[1] Y.-S. Chen, Y.-C. Wang, M.-H. Kao, and Y.-Y. Chuang. Deep photo enhancer: Unpaired learning for image enhancement from photographs with gans. In *Proceedings of IEEE International Conference on Computer Vision and Pattern Recognition (CVPR 2018)*, pages 6306–6314, June 2018.

[2] M. Gharbi, J. Chen, J. T. Barron, S. W. Hasinoff, and F. Durand. Deep bilateral learning for real-time image enhancement. *ACM Transactions on Graphics (TOG)*, 36(4):118, 2017.

[3] Y. Hu, H. He, C. Xu, B. Wang, and S. Lin. Exposure: A white-box photo post-processing framework. *ACM Transactions on Graphics (TOG)*, 37(2):26, 2018.