EFFICIENT MULTI-COLLECTION STYLE TRANSFER USING GAN[ID: 81]

FAN BU [FANBU@SEAS.UPENN.EDU],
RUNZHI ZHOU [ZRZ@SEAS.UPENN.EDU],
ZHAOZHENG SHEN [SHENZHZH@SEAS.UPENN.EDU],

ABSTRACT. Generative Adversarial Network (GAN) is a widely adopted framework for style transfer. However, GAN rely on sufficient amount of style images and can only transfer into one style in a single model. In this project, we propose a a new model that can make style transfer from single style image, and allow to transfer into multiple different styles in a single model.

1. INTRODUCTION

Style transfer technique enables amateurs to produce fantastic and versatile images in seconds, so that it has many practical applications in cartoon generation, oil painting re-rendering and art education, etc. Generative Adversarial Network (GAN) is a widely adopted framework for style transfer. However, most methods for style transfer rely on sufficient amount of style images to train the model. In our project, we propose to implement P2-GAN[6] first, which efficiently learn the style from a single style image. In addition, collection style transfer tries to stylize a photograph by mimicking an artist's style. Here, we want to further apply Gated-GAN[1] in our model, which can transfer multiple styles in a single model, to build a model that can make style transfer from single style image, and the styles are controlled by switching different gated-transformer module.

2. PRIOR ART

Most early works on style transfer were pixel-level approaches that relied on low-level visual features. Since Gatys for the first time incorporated convolutional neural networks (CNNs) into the computations of style loss and content loss, CNNs based approaches have become the mainstream of style transfer and achieved convincing results. These methods can be divided into three categories: a) online learning methods[2] [4], patch-swap methods[3][5], and offline learning methods. Generative Adversarial Network (GAN) is a widely adopted framework toward this task for its better representation ability on local style. However, when the number of style images is only one, traditional training methods of GANs will not work due to single sample can not represent a distribution, a novel Patch Permutation GAN (P2-GAN) network[6] was proposed to overcome this problem. In P2-GAN, a patch permutation module and a patch discriminator are proposed, together with an improved encoder-decoder generator for more efficient computation on both offline and online stages. In addition, Gated-GAN[1] introduced the gated transformer module to integrate multiple styles within a single generated network. The generative network consists of three modules: an encoder, a gated transformer, and a decoder. Images are generated to different styles through branches in

the gated transformer module. The discriminative network uses adversarial loss to distinguish fake image and real image, and the auxiliary classifier supervises the discriminative network to classify the style categories.

3. Methods

We will first try to implement a model that can make style transfer from single style image. The styles are controlled by switching different gated-transformer module. We will prepare data for style transfer, and implement Patch Permutation GAN network. Secondly, we will apply Adversarial Gated Networks for Multi-Collection Style Transfer in our model. In the end, we will try to combine the two models to see if we can possibly allow the model to transfer style of multi-Collection, while maintaining good image quality and fast computational performance. If time permits, we also plan to explore the use of different loss functions or speed up the training process.

4. Timeline and splitting of work

- Week 1: Prepare data for style transfer
- Week 2: Try Patch Permutation GAN network
- Week 4: Organize data, compare models, and write project report

References

[1] Xinyuan Chen et al. "Gated-GAN: Adversarial Gated Networks for Multi-Collection Style Transfer". In: *IEEE Transactions on Image Processing* 28.2 (Feb. 2019), pp. 546–560. ISSN: 1941-0042. DOI: 10.1109/tip.2018.2869695. URL: http://dx.doi.org/10.1109/TIP.2018.2869695.

[2] Leon A. Gatys, Alexander S. Ecker, and Matthias Bethge. "Image Style Transfer Using Convolutional Neural Networks". In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*. June 2016.

[3] Chuan Li and Michael Wand. *Combining Markov Random Fields and Convolutional Neural Networks for Image Synthesis*. 2016. arXiv: 1601.04589 [cs.CV].

[4] Chuan Li and Michael Wand. "Precomputed Real-Time Texture Synthesis with Markovian Generative Adversarial Networks". In: *CoRR* abs/1604.04382 (2016). arXiv: 1604.04382. URL: http://arxiv.org/abs/1604.04382.

[5] Jing Liao et al. *Visual Attribute Transfer through Deep Image Analogy*. 2017. arXiv: 1705.01088 [cs.CV].

[6] Zhentan Zheng and Jianyi Liu. *P^2-GAN: Efficient Style Transfer Using Single Style Image*. 2020. arXiv: 2001.07466 [cs.CV].