Artificial Intelligence Artistic Painting Mirror as Interactive Art Using Deep Neural Networks

Yasuo Kuhara

Tokyo Polytechnic University, 2-9-5 Honcho, Nakano, Tokyo 164-8678, Japan

ABSTRACT

This paper reports a summary of the project named "Basic research on interactive art using deep learning to create color expression," which has been adopted as a private university research branding project on the research of color science and art. In this project, I have developed an interactive artform named "AI Artistic Painting Mirror" using deep-learning neural networks. This work transforms images from a camera into an artistic style movie in real time, as if it were a mirror, using deep neural networks that have learned various styles of painters in advance. The AI artistic painting mirror has been exhibited at several galleries and festivals. It has achieved stable performance and a good reputation.

1. INTRODUCTION

Artificial intelligence (AI) has interesting possibilities in the field of art, where intuitions and feelings are important. For example, applications that transform photographs into artist-styled paintings are very popular. Several libraries for artistic transformation by neural networks have been developed and published on the Internet. For example, E. Matsumoto developed "chainer-gogh" [1], which is an implementation of the "Neural Algorithm of Artistic Style" by Gatys et al. [2]. Furthermore, Y. Tomoto developed "chainer-fast-neuralstyle" [3], which achieved faster transformation than chainer-gogh. As an application of fast artistic style transfer using neural networks, I have developed an interactive artform named "AI Artistic Painting Mirror" (see Figure 1).

2. CONCEPT

Painters express what they see with their own eyes as a painting based on their own unique sensibility. They cannot explain it in words, because it is beyond the algorithmic process and reflects the unique visual experience that painters have been exploring. This work is an interactive painting form, which creates an image input from the camera with artistic styles featuring the characteristics of various painters using artificial intelligence called deep learning. When a viewer performs various actions, they are transformed into images expressed in a painting style in real time, and this is reflected on an organic EL display like a mirror. This style transformation is performed by a convolution neural network learning visual perception such as object and face recognition. In the examples in Figure 2, the right-hand side is the style image and the left-hand side is the generated image. We can understand that the original image is repainted with the style image, and not only color sense but also fine space patterns are expressed according to the painter's style. Works used for learning are Da Vinci, Van Gogh, Renoir, Munch, Picasso, Matisse, Mondrian, Sharaku, and Hokusai, as well as ancient Egyptian mural paintings. Viewers can take various poses in front of the camera and enjoy their own figure drawn in a particular painting style (see Figure 1).

Fig. 1 AI Artistic Painting Mirror

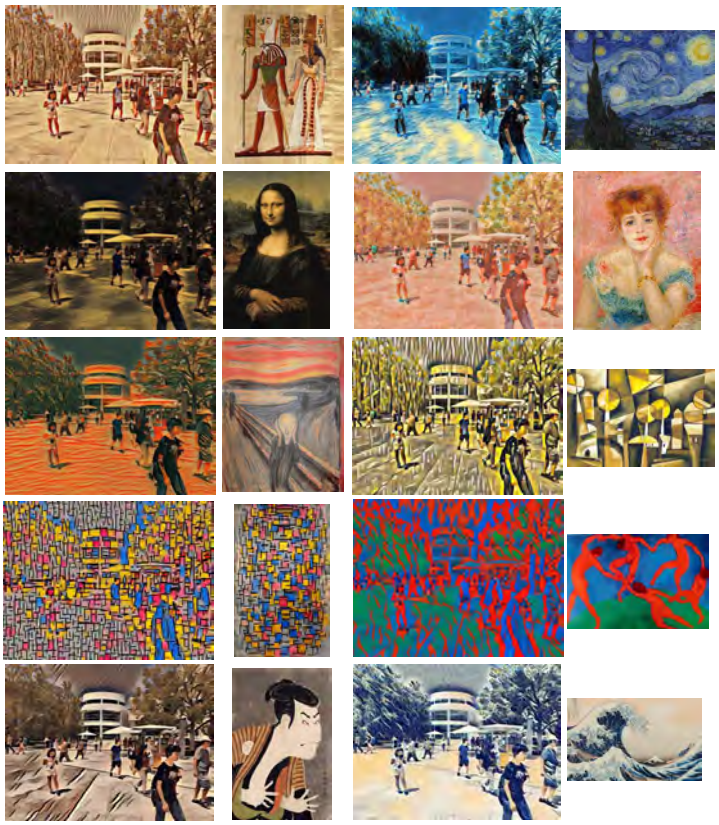

Fig. 2 Sample Pictures

3. METHOD

3.1 System Configuration

For a calculation for deep learning, we should use a highly specialized general-purpose computing on graphics processing units (GPGPU) workstation, which is a computer optimized for deep learning. For this equipment, we employed HPC Systems' HPC5000-XBWGPU4TS, which has a Xeon processor, and four NVIDIA Tesla-series GPUs, in a specialized computer room for deep learning in the facilities of our university. We can connect and use it directly and through our university intranet.

3.2 Neural Networks

We use the chainer-fast-neuralstyle application by Tomoto [3]. It is a Chainer implementation of "Perceptual Losses for Real-time Style Transfer" by Johnson et al. [4]. This method builds on "A Neural Algorithm of Artistic Style" by Gatys et al. by training feedforward neural networks that apply artistic styles to images [2]. Johnson's method can stylize images hundreds of times faster than the optimization-based method presented by Gatys. They train one image transformation network model per one style target. This models are trained on the Microsoft COCO dataset, which has gathered images of complex everyday scenes containing common objects labeled using per-instance segmentations to aid in precise object localization [5].

3.3 Performance

Response from camera input to display artistic images is important as an interactive arrform. Using GPU increases the calculation performance dramatically, ten or hundred times more than normal CPU. Additionally, image resolution relates to performance. A high-resolution image creates beautiful graphics but the latency is slow. In the case of high vision quality, the response time is 1 to 2 seconds. On the other hand, in the case of VGA quality, the response time is 0.2 to 0.5 seconds. In the exhibition, we prioritize graphical beauty for a painting of fine art.

4. EXHIBITION

4.1 Color and Science Laboratory Gallery

I am attending the rotating exhibition entitled "Explorer of Color" of the International Research Center for Color Science and Art at Tokyo Polytechnic University (see the upper left of Figure 3). This exhibition is held from September 15, 2018 to April 19, 2019. Every month, two or three hundred visitors including students from preschool to high school visit our gallery and enjoy this exhibition.

4.2 Festa in the Faculty of Arts

We attended the annual art event "Gather Art! Spread Art! " of the Faculty of Arts at Tokyo Polytechnic University (see the upper right of Figure 3). This exhibition was held on October 7 - 24, 2018. More than two thousand visitors enjoyed this exhibition.

4.2 Chika Fes of Atsugi City

Responding to a request from Atsugi City, we exhibited this work at Chika Fes of Atsugi City on November 10 and 11, 2018. *Chika* means an underground pavement. At this festival, many families, children, and adults, accounting for 975 visitors, the Mayor, and Ayukoro-chan as the city's mascot watched it and enjoyed their figures transformed into artistic style (see the lower left and right of Figure 3).

5. PERSPECTIVE

We have developed the AI Artistic Painting Mirror. In the exhibition, visitors enjoyed our interactive work more than we expected. In the future, we have plans for collaboration with other artists such as photographers and exhibition-holders in foreign countries. Neural networks can learn any style of artistic graphics for adapting to specific artists or museums. We hope our work in various display styles will prevail.

6. ACKNOWLEDGMENT

This research was supported by "Polytechnic Color Science and Art Creating Tomorrow, Studying the Future, and Connecting the World through Color" as a private university research branding project.

7. REFERENCES

[1] E. Matsumoto, "chainer-gogh," https://github.com/yusuketomoto/chainer-fast-neuralstyle.
[2] Gatys et al., "A Neural Algorithm of Artistic Style," http://arxiv.org/abs/1508.06576, 2015.
[3] Y. Tomoto, "Chainer implementation of Perceptual Losses for Real-Time Style Transfer and Super-Resolution," https://github.com/yusuketomoto/chainer-fast-neuralstyle.
[4] J. Johnson et al., "Perceptual Losses for Real-Time Style Transfer and Super-Resolution," https://arxiv.org/abs/1603.08155, 2016.
[5] T. Lin et al., "Microsoft COCO: Common Objects in Context," https://arxiv.org/abs/1405.0312, http://cocodataset.org/.

Fig. 3 Exhibitions