Art in the Age of Artificial Intelligence: Japanese Artistic Painting Style Transfer through Neural Networks

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Introduction

What makes a great artist? The greatest artists have always been defined by their unique style. Leonardo da Vinci evoked curiosity with the hidden messages in his works such as *The Last Supper*. Vincent van Gogh introduced a sense of movement and flow in his famous *The Starry Night*. The Japanese artist Katsushika Hokusai deployed woodblock prints to give us one of the most memorable Japanese art works in *The Great Wave off Kanagawa*. And Yayoi Kusama used installation art to acquaint us with psychedelic colors, repetition, and pattern in *All the Eternal Love I Have for the Pumpkins*.

"Art is an utterly important tool that allows human beings to express emotions and ideas created in our imagination. It plays a fundamental role in a social context that can bring insight and understanding and also be entertaining" (Roza 2019). For thousands of years, paintings have been popular, and recreating them is time-consuming and requires much training. This process, however, has been expedited with the rise of new tools and technology (Moura 2007), such as Artificial Intelligence (AI), which has been applied and integrated into our everyday life (Machado et al. 2007, 818; cf. Taigman 2014, 1).

Art in Japan

Art in Japan has a long and rich history; the earliest people to settle in the Japanese islands can be traced back to as early as the tenth century BCE, when they created art using various mediums (Mason 1993). The Jomon Period is the "earliest" era in Japanese history, and is known for their pottery, which is the oldest not just in Japan but also in the world. It is distinct for its "corded" designs that are imprinted on clay (Hoang 2016). Historically, Japanese culture and art were heavily influenced by the Chinese, who introduced new artistic techniques and styles (Kaminishi 2006). But Japanese art is distinct from its cultural influences, and has developed its innovative style and themes. For instance, early in their history, the Japanese developed the *yamato-e*, which betrayed Sinic influences but also substituted indigenous motifs for certain Chinese ones (Japan Objects 2021).

As time progressed, so did Japanese pottery and art, taking on other forms and media, such as the tea ceremony, which greatly contributed to the development of the arts and crafts. Distinct for its earth tones, it boasts of the *wabi-sabi* aesthetic ("a philosophy of imperfection and impermanence") (Japan Objects 2021) and encompasses not just the ceramics industry but also the "textile, incense, metalware, woodwork" and other enterprises (Japan Objects 2021). During the Edo period, the production of modern ceramics began in Akita, whose pottery and porcelain came into renown. After World War II, a "technique" called *neriage* was developed (Japan Objects 2021).

Samurai art is also well-known in Japan. Apart from being warriors, they were also "poets, artists, collectors, or sponsors," and their craftsmanship could be seen through intricate "armors and weapons." Printing techniques also advanced during the Edo era, particularly colored woodblocks, and had widely diverse themes. During and after the Meiji Restoration of 1868, Japanese art began to modernize (Japan Objects 2021). Today, Japanese artists keep innovating and experimenting with different styles and craftsmanship in textile printing, painting, architecture, "digital

sculpture and photography," as evident in the striking and experimental works—in various media—of Junko Mori, Takahiro Iwasaki, Chiharu Shiota, and Takashi Murakami (Japan Objects 2021).

This essay explores the applications of algorithms and computational machines on art. Highly associated with computers, an algorithm is a computational procedure that takes a value as *input* and produces a value as *output*. It can also be "viewed as a tool to solve a well-specified computational problem" (Cormen et al. 2009, 5). Moreover, algorithms can be viewed as "a computer program" or as a "hardware design" (6).

Thus, computational machines or computers use algorithms via input and output procedures to tackle a specific problem. Using artistic style transfer, this paper attempts to employ an artificial intelligence (AI) algorithm in creating art based on the styles of selected Japanese art works. Specifically, I experimented with Neural Style Transfer, an AI-based technique applied by Gatys et al. (2015, 2016), to see if it can understand the distinct painting styles from Japanese artworks and transfer them to other images.

Art, Technology, and Artificial Intelligence

The desire to develop computational methods with artistic capabilities dates to more than 150 years ago when Ada Byron dreamed of a computer that can create music (Moore 1977 cited in Roza 2019). Artistic tools have evolved since. After the paintbrush came photography and later on, film. In the digital age, software can create art, such as that in 3D animation.

Art, like technology, continually pushes boundaries. The most progressive and forward-thinking individuals embrace the potential of new technology. A famous example is the artist David Hockney, who switched to an iPad from the traditional paintbrush-and-canvas. In the world of animation, Pixar's Ed Cartmull was driven by a belief that 3D graphics could allow a new form of storytelling. Japanese artists have caught up with the new technology. For instance, the artist, Seikou Yamaoka, creates digital artworks from his iPhone (Sieczkowski 2012).

The first artwork generated by Artificial Intelligence (AI), *Portrait of Edmond Belamy*, was auctioned at Christie's (2018). It was signed by the mathematical formula that helped create it. Artificial Intelligence (AI)-based algorithms signal for a new era of creativity. Though AI-based algorithms are not always predictable when they are applied to an image, the results are often surprising and delightful. The same could be said for the way watercolor flows on the page.

Deep Learning and the Arts: Neural Style Transfer

The neural network is an algorithm belonging to the field of Artificial Intelligence. It is composed of several layers of code blocks, in which a computer learns to perform complex tasks involving complex data (such as images, speech audio, etc.) through the use of thousands of bits of information. However, neural networks are lagging behind in tasks involving creativity (Machado et al. 2007). If neural networks can improve creativity tasks, it would open new fields and opportunities.
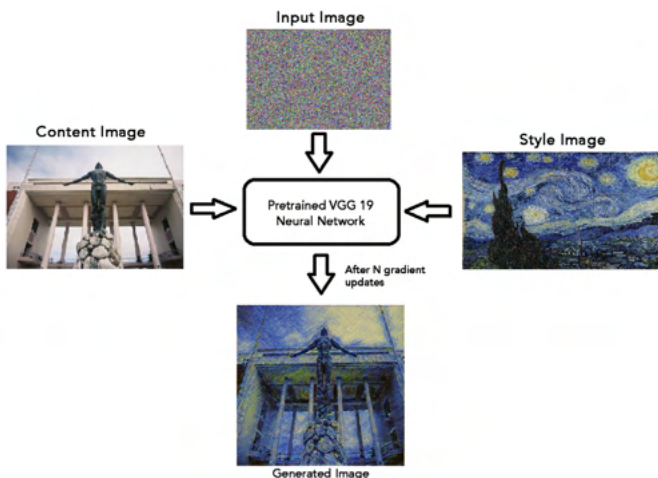

Figure 1: An overview of neural style transfer with my photo of the UP Oblation as the content image and Van Gogh's Starry Night as the style reference image. See Gatys et al. (2015, 3), which also uses Van Gogh's famous painting.

Convolutional Neural Networks (CNN) is a type of neural network that is trained to recognize objects (Gatys, Ecker, and Bethge 2015). Using parts of the CNN, engineers figured out how to apply it to creative tasks via neural style transfer, which uses a content image and a style reference image (i.e. paintings) to create another image similar to the former, but is in the style of the latter (Gatys, Bethge, Hertzmann and Shechtman 2016).[1] An overview of Neural Style Transfer is shown in Figure 1.

Neural Style Transfer and Japanese Art

I implemented Neural Style Transfer featured in Gatys et al. (2015, 2016) using Japanese art works as the "style" images. The instructions from Gatys et al. are in the form of a code that is sent to a computational machine (computer) to achieve the desired result (in my case, a processed image). The algorithm can be considered AI since it was trained on a large dataset—i.e., thousands of images—to understand highly advanced concepts such as "content" and "style."[2] The results are ideal when the number of iterations is set to 500. The iterations refer to the number of times in which the neural network is "trained" on the data in order to receive feedback on how good the output is. Through Gatys et al.'s work (2015, 2016), I was able to transfer the style of Japanese paintings onto some of my holiday photos.

As shown in Figure 2, I was able to transfer the style of *The Great Wave off Kanagawa* by *ukiyo-e* artist, Hokusai, onto a photo I took at Coron, Palawan. I was able to create a new image with little experience in painting.

Figure 2: Results of Neural Style Transfer with my photo of Coron, Palawan as the content image, and with *Great Wave off Kanagawa* by Katsushika Hokusai (c. 1829-32) as the style image (The Art Story n.d.).
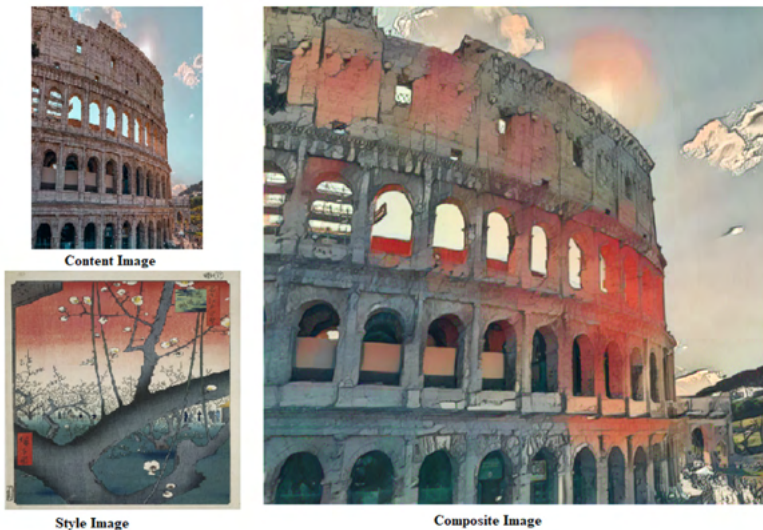

Figure 3: Results of Neural Style Transfer with my vacation photo of the Roman Colosseum as the content image, and *Plum Garden at Kameido* as the style image (Google Arts & Culture n.d.).

For Figure 3, I transferred the style from the woodblock print, *Plum Garden at Kameido* by *ukiyo-e* artist, Hiroshige, into the image of the Roman Colosseum from Rome, Italy.

Lastly, Figure 4 shows the art I made using a photo of the 2020 Taal Volcano eruption as the content image, and *Mt. Penglai* by Tomioka Tessai as the style image.

Figure 4: Results of Image Style Transfer with photo of Taal Volcano eruption on January 2020 (Wikimedia Commons n.d.) as the content image and *Mt. Penglai* (Mountain of Immortals) by Tomioka Tessai (1924) as the style image (Google Arts & Culture n.d.).

Conclusion

I find it fascinating how a neural network was able to understand the image, as well as complex concepts such as content and style. Results from my use of CNN—following Gatys et al. (2015, 2016)—are mostly decent, especially when the main colors of the scenery photo match those of the style image. Neural style transfer can help create new and innovative

artworks by allowing artists to share their creative artistic style. This new technology could help benefit artists and their creative industries such as Japanese animation by providing them with a new tool that can increase productivity and facilitate the creative process.

The preceding discussion brings up several issues. First, Japanese artists are inspired by people, places, culture, and traditions. Artists use their craft to tell stories and make sense of the world. An algorithm might create interesting images, but it lives on an "island" that lacks social context. It cannot tell stories the way Japanese artists can. For example, in Figure 3, an art critic might argue that it might not make sense because, historically, Palawan rarely experiences earthquakes and has no active volcanoes. Thus, it is highly unlikely to experience waves as depicted in *The Great Wave off Kanagawa.*

Second, AI technology does make art more reproducible. In this age where cameras, smartphones, computers (e.g. tablets, laptops), social media are ubiquitous, it is however difficult to quantify and isolate the contributions of AI technology in making art more reproducible, since this could also be credited to other technologies. Similarly, AI technology might be said to diminish the "aura" of Japanese art, to adopt Walter Benjamin's term. I do not believe so, however, since other tools such as cameras and photography have been used for a long time. Such machines do most of the work, and yet it has not come to my attention that cameras or photography diminish the aura of artworks. Personal photographs of art taken for private viewing do not harm artists. Rather, the opposite could be argued that technology, such as photography, the internet, and social media, has boosted the recognition, awareness, and value of artworks, especially to the younger generation. Thus, the work of an artist is not diminished since his/her work is still original. Neural style transfer can simply be thought of as a tool to widen the reach of his/her artistic style.

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Declaration of Funding and Conflict of Interest

Endnotes

[1] CNN is a type of neural network (NN) used to classify images, and not to create art. It was through Gatys et al. (2015, 2016) work that I found a way to use parts of the CNN for artistic application. In another paper, Gatys and his colleagues refer to this work as "Neural Artistic Style Transfer" but in the AI community, the shorthand version, Neural Style Transfer, is more commonly used.

[2] I did not use any software. Software is different from an algorithm since there are features, such as a user interface, that make software more of a finished product than an algorithm. In layman's terms, an algorithm is simply a set of instructions to solve a problem. If you want to convert it to the software, you usually need a team of engineers to add features such as a user interface so that they will not have to go through the difficulty of understanding all aspects of the code, tuning it, and even fixing errors that might come as they use it. For my purposes, implementing the aforementioned algorithm was enough to achieve my desired results. Classical algorithms need more human input from the user and cannot achieve the same quality due to certain limitations that can only be overcome by AI.

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