The artistic style transfer from Shanghai modern landmark buildings images to Xiao Jiaochang New Year pictures based on deep learning

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Abstract. Posting New Year pictures is a folk custom with a long history in China. Shanghai New Year pictures are loved by the people with its unique Shanghai style. As a representative of Shanghai New Year pictures, Xiao Jiaochang New Year pictures have left a strong mark in the history of Shanghai style culture and history through its diverse and comprehensive categories and rich artistic styles. However, due to its short well-developed period, the New Year pictures in Xiao Jiaochang have no inheritance and cannot apply for intangible cultural heritage. Nowadays, it is not realistic for us to use the traditional way to make New Year pictures in small schools because of the lack of inheritors and the production techniques have not been continued. Therefore, this paper mainly focuses on tracing back to this period of history, and realize the recording and dissemination of the style of the New Year pictures of Xiao Jiaochang through modern high-tech. Collect the relatively complete New Year pictures of Xiao Jiaochang in the world as a data set, and realize the style transfer to modern Shanghai's landmark buildings’ pictures through the method of machine learning. Realizing the electronic work on spreading the culture in addition to the normal electronic record needs to be in time, so that Xiao Jiaochang New Year pictures can reappear in the world.

1. Introduction

1.1. Xiao Jiaochang New Year pictures
Due to a series of reasons, such as the lack of inheritors, Shanghai Xiao Jiaochang New Year pictures cannot be included in the intangible cultural heritage list like other traditional New Year pictures. However, its inheritance and development of Taohuawu New Year pictures in Suzhou, as well as its strong regional colour and distinctive artistic features, all show its historical and cultural value, which also helps to deepen our understanding of the city Shanghai. There is no doubt that it is still an important part of the development of Chinese folk arts and crafts. Therefore, the protection and inheritance of New Year wood-block pictures, especially the rare cultural heritage of Shanghai Xiao Jiaochang New Year pictures, still need the efforts and participation of all sectors of society. Only inheriting the traditional and static protection is not enough any longer, instead, trying to make the traditional art live and recreate the tradition by various methods is the new purpose, so as to promote its further development in modern society. [1] Due to the particularity of the times, the classification of the New Year pictures in Xiao Jiaochang is complicated. According to the content, it can be divided into blessing and auspiciousness, folk customs, foreign life, news and current events, maritime customs and new fables. The change of its printing carrier reflects the drastic changes in society. The New Year pictures reflected a lot of news, current events and people's social mentality at that time.
Also, it contains a lot of language at that time. Therefore, the New Year pictures of Xiao Jiaochang are not only common folk things, but also integrate aesthetic and literature learning. Among more than 20 producing areas of New Year pictures in China, many local New Year pictures have been protected as intangible cultural heritages. However, according to incomplete statistics, there are only about 1000 Xiao Jiaochang New Year pictures still exist in the world. Only half of them are left in China, and the other half are in other countries. It is hard for ordinary citizens to see them. The New Year pictures from Xiao Jiaochang are becoming more and more endangered. How to protect them has become an urgent problem. Therefore, finding some ways or methods to let more people pay attention to the New Year pictures from Xiao Jiaochang is urgently needed.

In this paper, the authors plan to transfer the style of the New Year's Picture from Xiao Jiaochang to the landmark building pictures of modern Shanghai by the image style transfer technology, so as to organically combine the style of the New Year picture from Xiao Jiaochang with the modern photos, and contribute to the inheritance of the New Year picture from Xiao Jiaochang. Convolution neural network is one of the most powerful deep neural networks in image processing. The convolutional neural network consists of a small computational unit that processes visual information in a feed-forward manner (Fig. 1). Each layer unit can be understood as a set of image filters. Each filter extracts a feature from the input image. Therefore, the output of a given layer includes the so-called feature map: different style versions of the input image.[2]

1.2. Shanghai landmark building[3]

1.2.1. The Oriental Pearl Radio & TV Tower.
Located in Lujiazui, Pudong New Area, the tower is about 468 meters high. The building was built in July 1991 and put into use in May 1995. The transmission antenna mast of the Oriental Pearl TV Tower is 110 meters long. It has the capability of transmitting 9 sets of TV sets and 10 sets of FM broadcasting programs. It can cover the whole area of Shanghai and its neighboring provinces within the radius of 80 kilometers, and has greatly improved the quality of listening. The Oriental Pearl TV Tower is the first major project after Pudong's opening up and development. Only 10 years after its completion, it received 295 foreign heads, held nearly 100 world-class conferences and more than 300 major events, and became an important window for Shanghai's external publicity. In addition, the Oriental Pearl Radio & TV tower has also created good tourism economic benefits. As of 2005, the number of visitors to the Oriental Pearl Radio & TV Tower reached 28 million 700 thousand, with an operating income of 2 billion 236 million Yuan. [4]

1.2.2. New world of Shanghai.
New world of Shanghai is a city tourist attraction with the historical and cultural features of Shanghai and the integration of Chinese and Western cultures. New world of Shanghai is based on Shanghai's modern architectural symbol, the old building of Shikumen. For the first time, the original residential function of Shikumen has been changed, and the commercial operation function has been given innovatively. This old house reflecting the history and culture of Shanghai has been transformed into a fashion, leisure, cultural and entertainment center with catering, shopping, performing arts and other functions. Walking in the new world of Shanghai makes you feel like you're in twentieth or thirtieth century. However, stepping into each building you will find it a very modern and fashionable, which makes you experience the unique concept of the new world of Shanghai. This organic combination and skillful arrangement make a symphony of yesterday, tomorrow and today in Shanghai, and let the tourists around the world feel the unique culture.[5]
1.2.3. China Pavilion of Shanghai World Expo-- China Arts Museum.
The China Arts Museum, which was rebuilt from the China National Pavilion of the 2010 Shanghai World Expo, opened on October 1, 2012, with a total construction area of 166,800 square meters, a display area of nearly 70,000 square meters and 35 exhibition halls. The public education space is nearly 20,000 square meters, and the total operating area of supporting derivative services is 3,000 square meters. Its main building is located at No. 205, Shangnan Road, Pudong New Area, adjacent to Metro Line 7 and line 8, with convenient transportation. The Chinese Arts Museum is a modern art museum with public welfare and academic characteristics. Its basic functions are collection and storage, academic research, exhibition, universal education and foreign exchange. Adhering to the principle of art serving humans, the Chinese Art Museum always takes the audience's demand as the first signal, adheres to the basic value orientation of public welfare, integrates the efforts of all sectors of society, strengthens cultural production and public service, and strives to become an elegant palace for the public to enjoy classic art and enhance artistic aesthetic education.[6]

2. Image Style-Transform Method

2.1. Principle
The authors assume that the basic idea of style transfer is to take pictures as training variables, and reduce the content differences and style differences with style pictures by optimizing pictures. After iterative training for many times, the generated images will be consistent with the contents of content images, and will also be consistent with the styles of style pictures.

When convolutional neural networks are trained for target recognition, they develop an image representation that makes the object information more and more explicit along the processing level.
Therefore, along the processing level of the network, the input image is converted into representations, which are more concerned with the actual content of the image than with the detailed pixel values. It’s easy to be directly visualized that the information contained in each layer about the input image by reconstructing the image only from the feature map of layer. The high level in the network captures the high-level content according to the object and its arrangement in the input image, but does not constrain the precise pixel value of reconstruction. In contrast, reconstruction from the lower layer only reproduces the exact pixel values of the original image. Therefore, the characteristic response at the high level of the network is called as content representation. In order to obtain the style of the input image, the authors use a feature space originally designed to capture texture information.[7] This feature space is based on the filter response of each layer of the network. It is composed of the correlation between the responses of different filters in the space of feature mapping. A static, multi-scale representation of the input image is obtained by including multiple levels of feature correlation. It captures the texture information of the image rather than the global arrangement. First of all, there’s a need to extract the effective features of the image. Here the authors use the classical vgg16 model. Vgg16 is a classic model. It has achieved good results on ImageNet by stacking 3x3 convolution layer and pooling layer.[8] They use the vgg16 model trained on ImageNet to extract useful features from images, which can help them to measure the content and style differences between the two images. In the task of style migration, they only need to extract a few of the more important layers, so they make some modifications to the pre training vgg16 model of Python. After modification, when using vgg16 to calculate the features of the input image, it will return four matrices to the features parameters. When they do style migration, they must ensure the content consistency between the generated image and the content image, and then they measure the content difference of the image by the feature map output by vgg16. The loss function used here is:

\[ \ell_{\text{feat}}(\hat{y}, y) = \frac{1}{C_j H_j W_j} \| \phi_j(\hat{y}) - \phi_j(y) \|_2^2 \]

\( \hat{y} \) is the input image (that is, the generated image); \( y \) is content image; \( \phi \) is VGG16; \( j \) is relu3_3; \( \phi_j(x) \) is the characteristic graph of layer \( j \) after the \( x \) image is input to VGG; \( C_j H_j W_j \) is the size of the feature map output from layer \( j \).
2.2.1 Collect the pictures of modern landmark buildings in Shanghai. The authors search for the internet and download some high-resolution pictures (which are larger than 1k, incase when cutting it into 512*512 it still looks clear).

2.2.2 Debugging code to achieve style migration. Due to the great differences in the integrity, clarity and color retention of the existing New Year pictures of Xiao Jiaochang, the authors conducted migration experiments by distinguishing several styles in the established data set.

3. Conclusions

As for the protection of intangible cultural heritage, China has been paying attention to it since the 1990s. The development of various digital technologies has promoted the process of digital protection. However, due to the limitations of digital technology at that time, most of the protection was still in the stage of digital storage. Until 2010, many scholars began to propose that digital protection should not only stay at the level of digital preservation, but should have stronger promotion force. Therefore, various new digital technologies began to be designed for intangible cultural heritage digital protection, such as virtual reality, 3D stereoscopic projection. It is still in the stage that theory is higher than practice though. In foreign countries, some common methods of intangible cultural heritage protection include establishing heritage protection laws, constructing intangible cultural heritage digital resource database, cooperating with enterprises to make use of resource advantages and network to carry out protective research, establishing cultural heritage protection projects and making online cultural heritage resources service system, and establishing the number of national historical and cultural memory. The digital project of culture for survival and development, museums, public libraries, archives and public cultural organizations to create online databases, special protection projects for a certain intangible cultural heritage, and so on[12]. This paper realizes the transfer of different styles of New Year pictures of small school yard to Shanghai modern landmark building photos, which makes the culture of small school yard continue in a new form, and makes its digital protection move from digital preservation to a new stage of combination of digital preservation and digital experience.
Figure 3. The training result of The Oriental Pearl Radio & TV Tower; New world of Shanghai and China Arts Museum.

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