



# Generating Handwritten Chinese Characters using CycleGAN

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## Introduction:

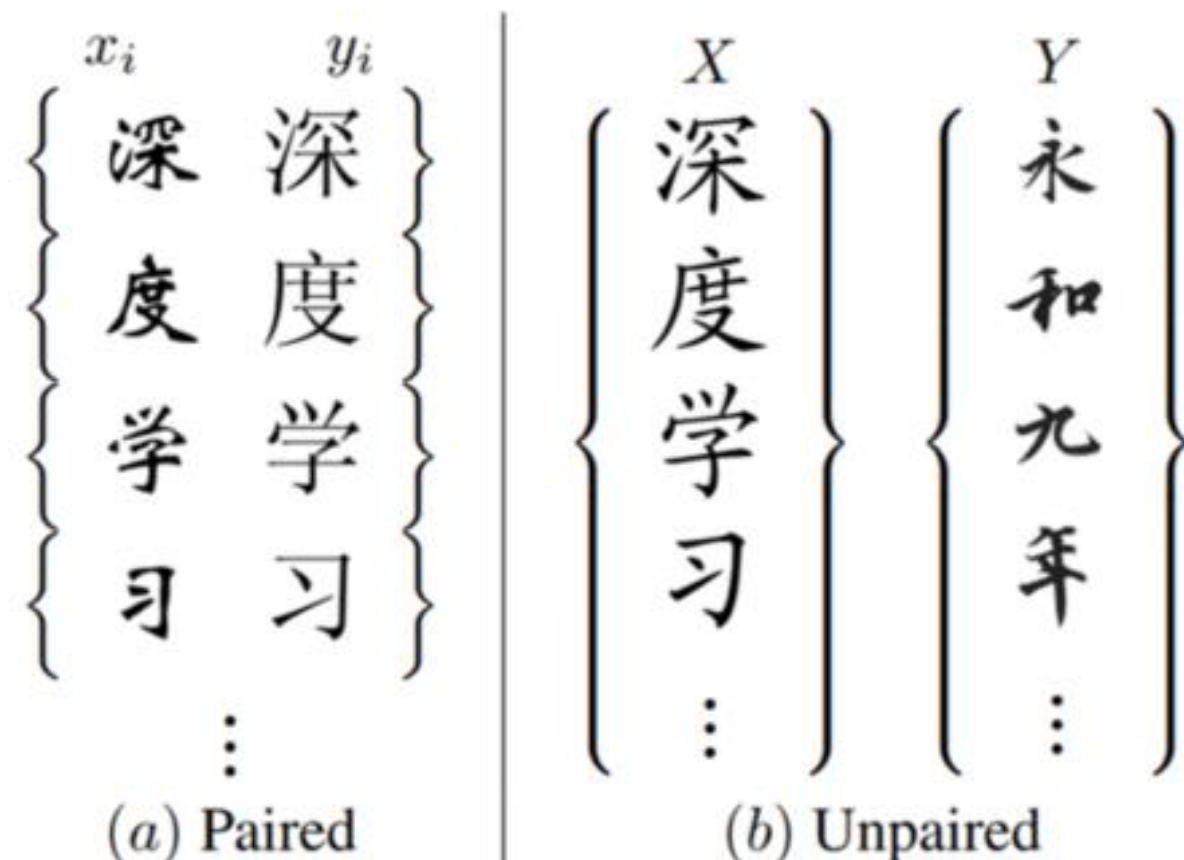


Figure 2: **Paired and unpaired training data.** (a) Paired training data consists of training examples  $\{x_i, y_i\}_{i=1}^N$ , where there exists correspondence between  $x_i$  and  $y_i$ . (b) We consider unpaired training data, where a source set  $X$  and a target set  $Y$  exist, with no matching information for  $x_i$  and  $y_i$ .

**Zi2Zi**  
完 灭 璿 櫨  
參 概 螺 蠶  
訪 揀 雨 弄  
痼 蛭 翱 淖



永永永永永  
(a) SIMHEI (b) SIMKAI (c) Lanting (d) HW252 (e) HW292

Figure 4: **The character “yong” in 5 different fonts.** (a) SIMHEI; (b) SIMKAI; (c) character in Lanting calligraphy dataset; (d) handwritten character from HW252 (1252-c.gnt) in HWDB1.1; (e) handwritten character from HW292 (1292-c.gnt) in HWDB1.1.

## Our Method:

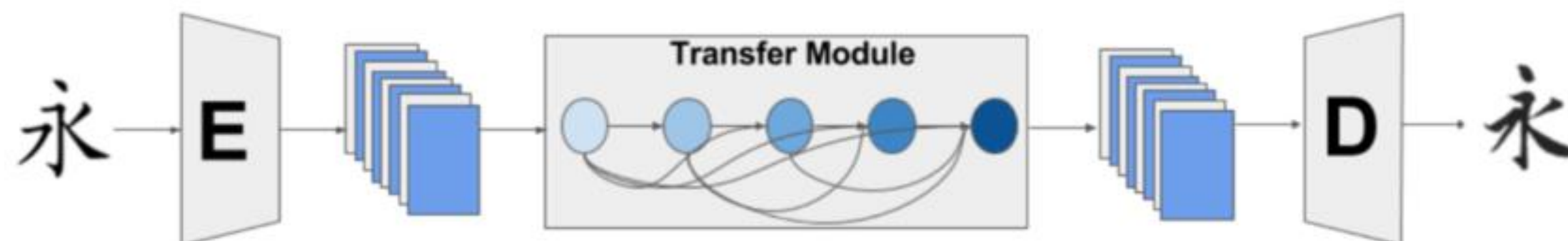
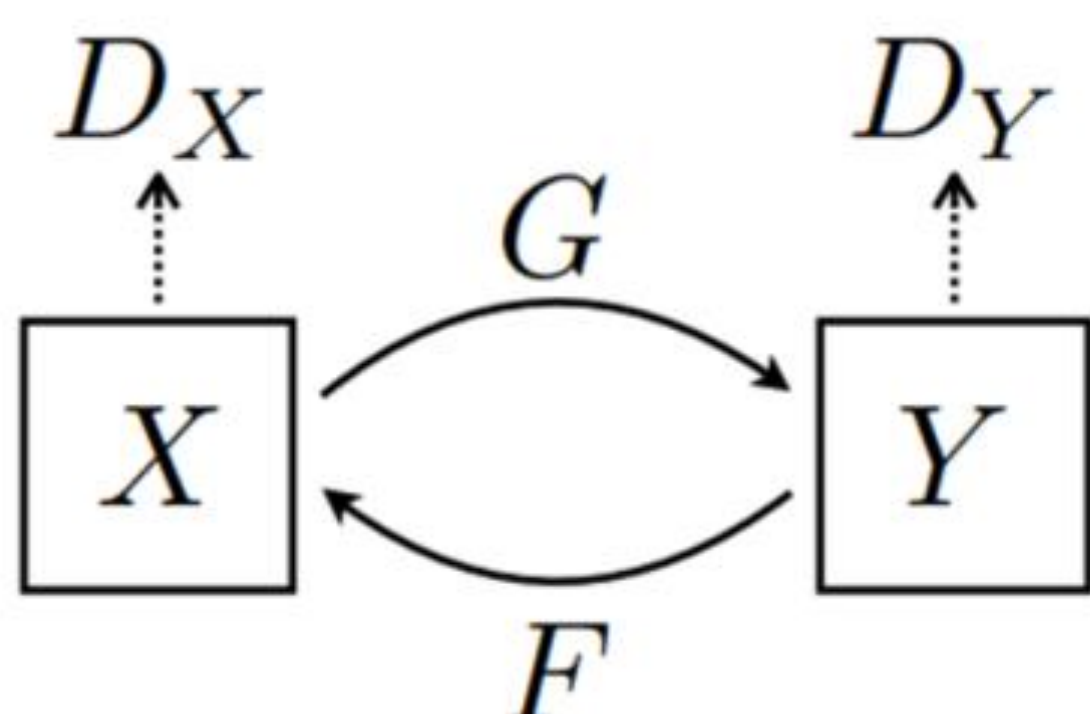
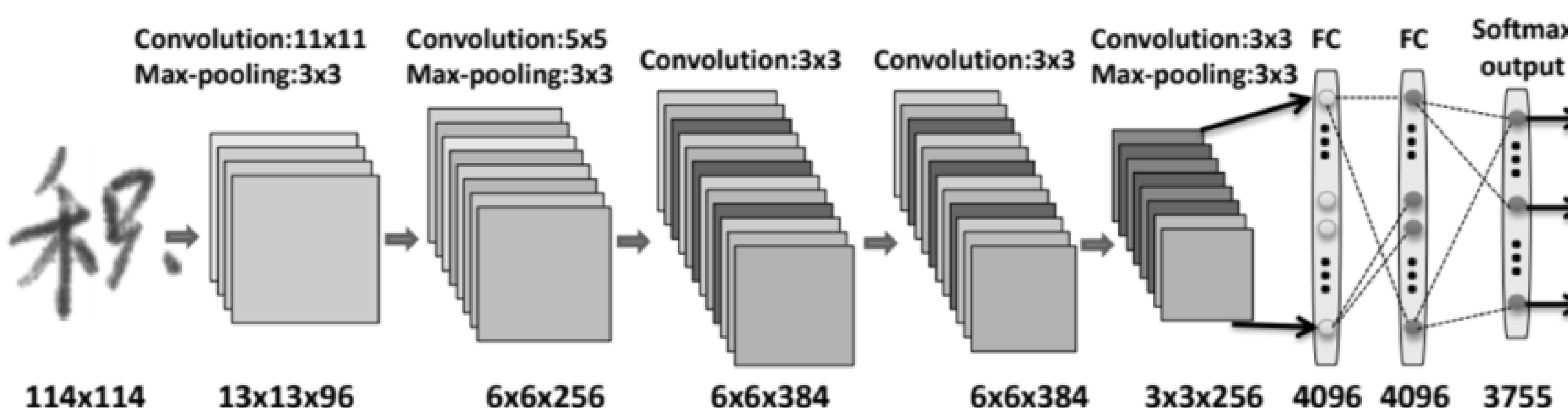


Figure 3: **The architecture of the generator in DenseNet-5 CycleGAN.** The information in the image in source style is first encoded to a lower dimensional space via the encoder  $E$ . Then the extracted features go through a transfer module, the outputs of which can be considered as the extracted features in the target style. Finally, the output of the transfer module is decoded via the decoder  $D$ .



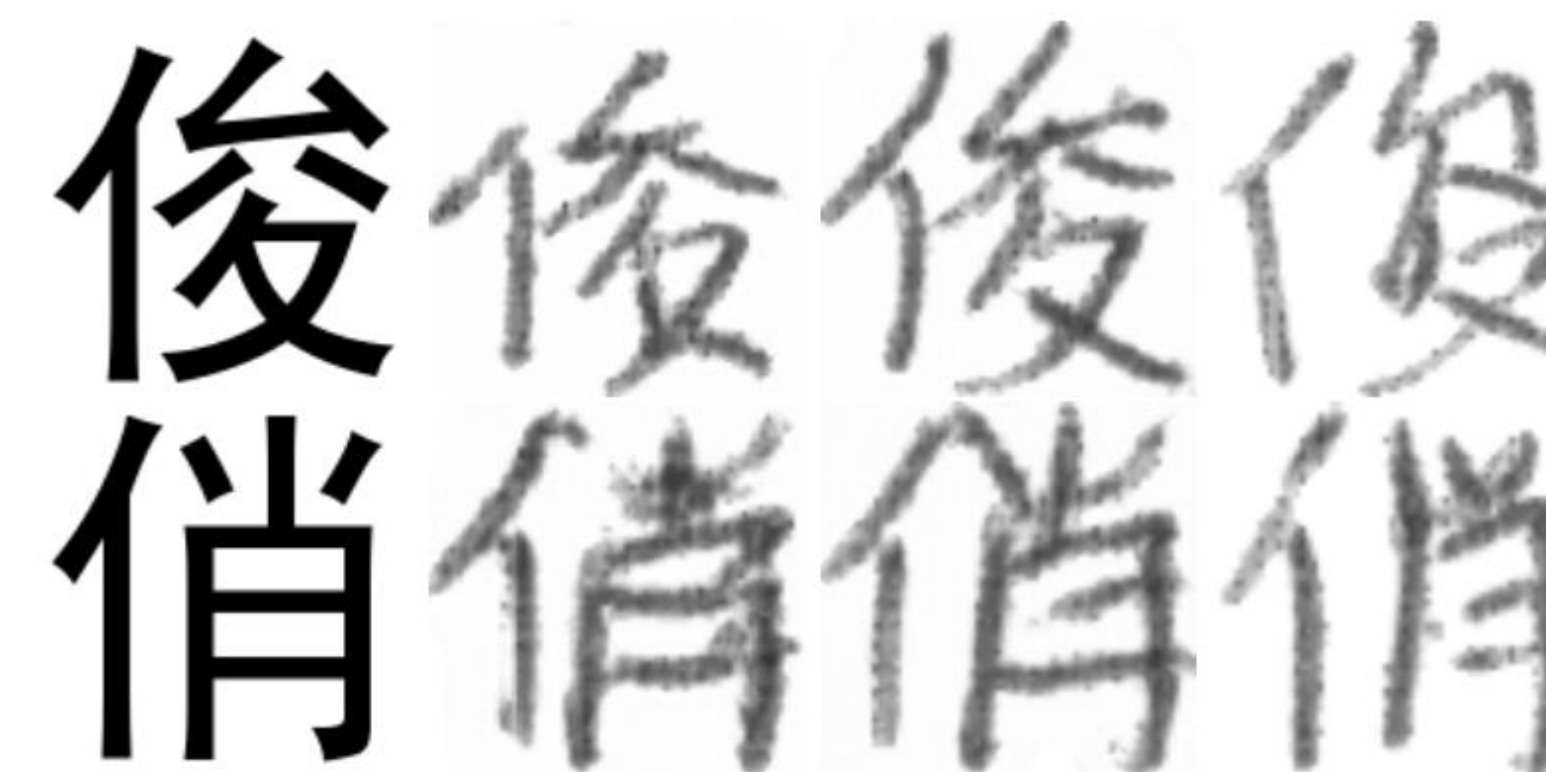
\* Source: Zhu, Jun-Yan, et al (2017).



**Content accuracy:** test accuracy of HCCR-GoogLeNet

**Style discrepancy:** root-mean square difference between the style representations of the target characters and the generated characters

## Results:



(a) SIMHEI (b) DenseNet-5 (c) ResNet-6 (d) HW252

Figure 5: **The handwritten Chinese characters.** (a) The source characters in SIMHEI font; (b) the generated characters in HW252's style using ResNet-6; (c) the generated characters in HW252's style using DenseNet-5; (d) the ground truth characters in HW252's style.



Figure 7: **The Chinese calligraphy characters in Lanting calligraphy dataset.** (a) The ground truth characters; (b) the generated characters in Wang Xizhi's style using DenseNet-5; (c) the generated characters in Wang Xizhi's style using ResNet-6. Note that for the character “he” in the second row, the strokes “throw-away” and “press-down” in the red circle are simplified to a single “break” stroke in the ground truth characters, but they are generated as separate strokes by DenseNet and ResNet CycleGAN.

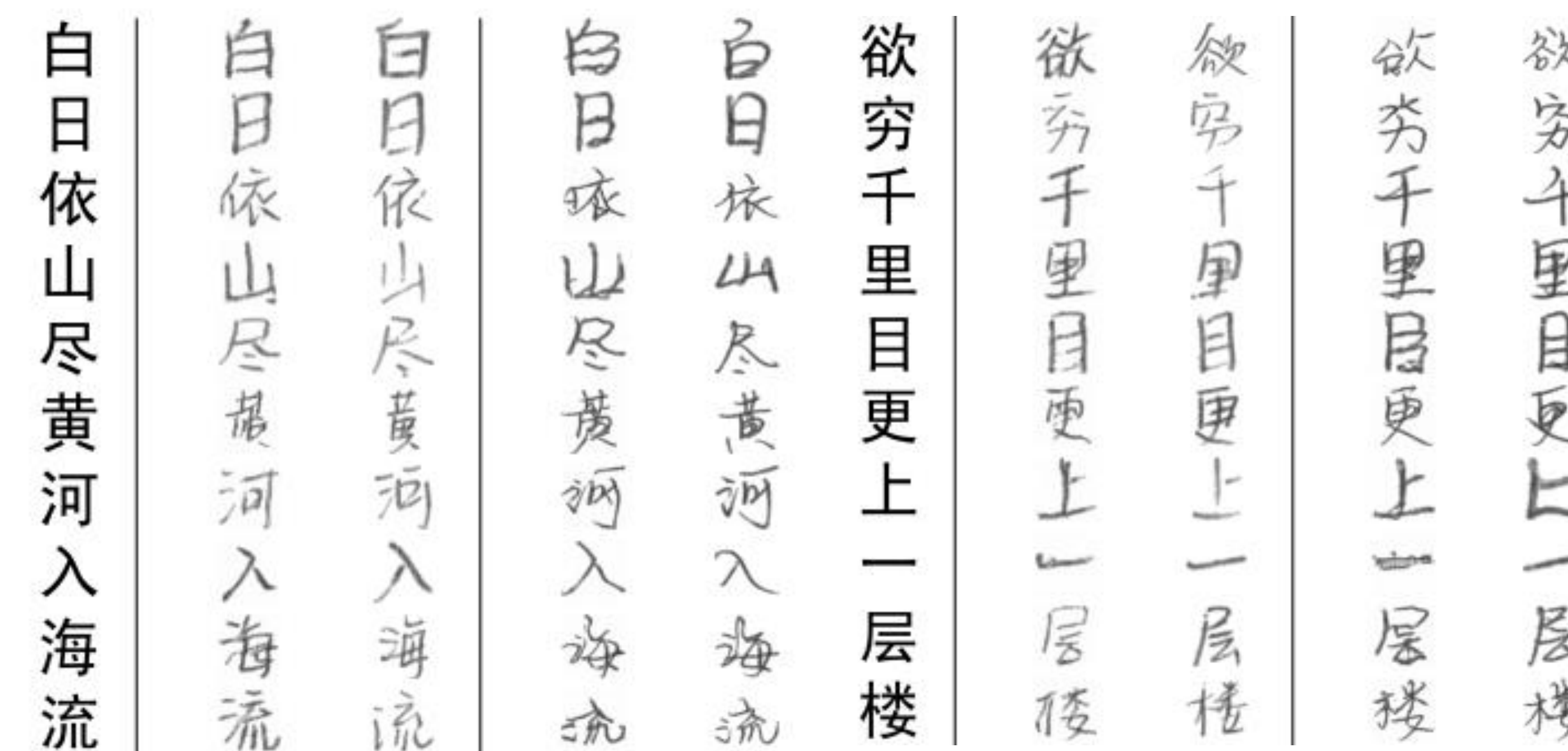


Figure 6: **A famous Chinese poem entitled “On the Stork Tower” generated by our proposed method.** (a) SIMHEI is the source style; (b) and (c) are two handwritten styles. The generated characters are clearly recognizable with personalized style.