DeepStyleCam: A Real-time Style Transfer App on iOS

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1. Introduction

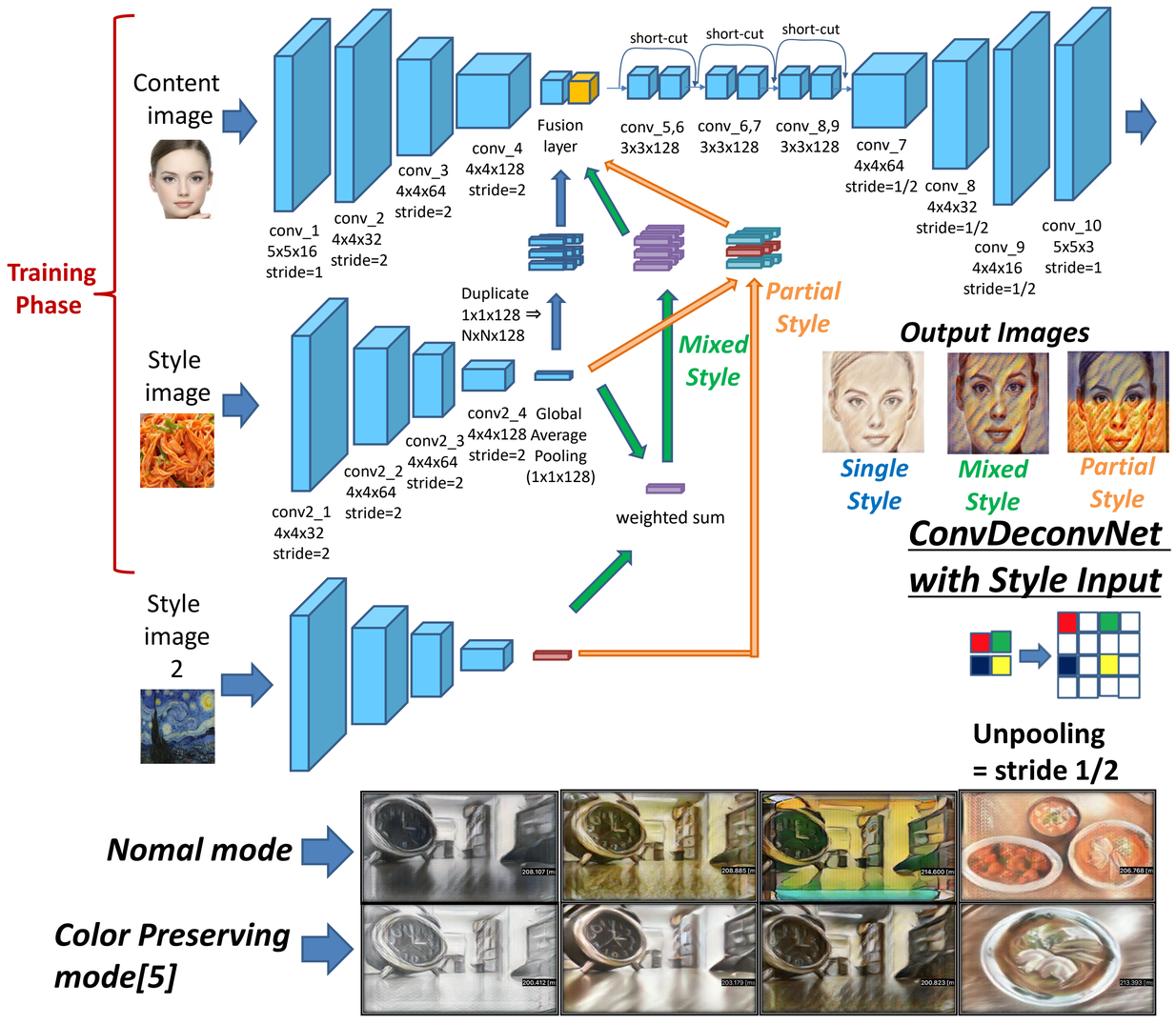
- In 2015, Gatys et al.[2] proposed an **algorithm on neural artistic style transfer**
  - synthesizes an image which has the style of a given style image and the contents of a given content image using CNN
- However, since the method proposed by Gatys et al.[2] required **forward and backward computation many times**
  - the processing time tends to become longer (several seconds) even using GPU

- Then, several methods using only feed-forward computation of CNN to realize style transfer have been proposed so far.
  - Johnson et al.[1] proposed **perceptual loss functions to train the ConvDeconvNetwork as a feed-forward style transfer network**
- However, **the ConvDeconvNetwork trained by their method can treat only one fixed style**.
  - **If transferring ten kinds of styles, we have to train ten different ConvDeconvNetwork independently.**
  - **This is not good for mobile implementation in terms of required memory size**.

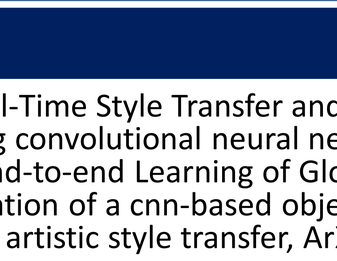
Then, **we modified Johnson et al.'s method so that one ConvDeconvNetwork can train multiple styles at the same time**

2. Proposed System

- ***We modified [1] can train multiple styles at the same time***
  - adding a fusion layer and a style input stream(inspired by [3])
- ***Training***
  - We input sample images to the content stream and style images to the style stream. (The training method is the same as [1])
- ***We shrunk the ConvDeconvNetwork compared to [1]***
  - added one down-sampling layer and up-sampling layer
  - replaced 9x9 kernels with smaller 5x5 kernels in the first and last convolutional layers
  - reduced five Residual Elements into three



Ex. Image Size: 250x250 ,
Computation: 1,303,800,800 times(13billion)
Parameter num: 1,250,835



175ms (iPhone7+)
180ms (iPad Pro)
200ms (iPhone SE)

3. Example

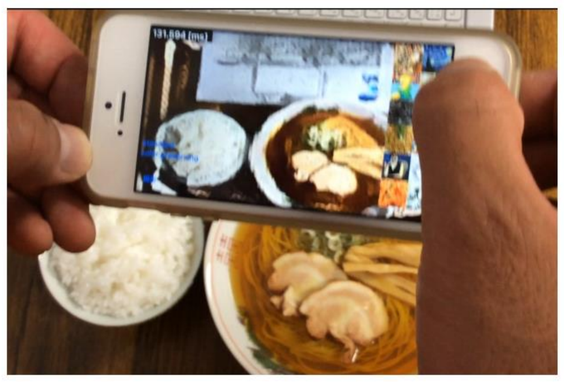


Fig. 1. "DeepStyleCam" running on an iPhone SE.

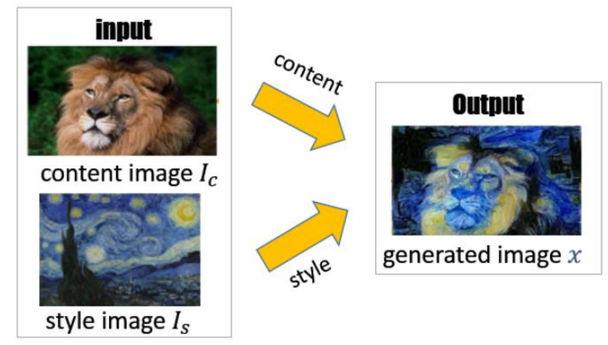
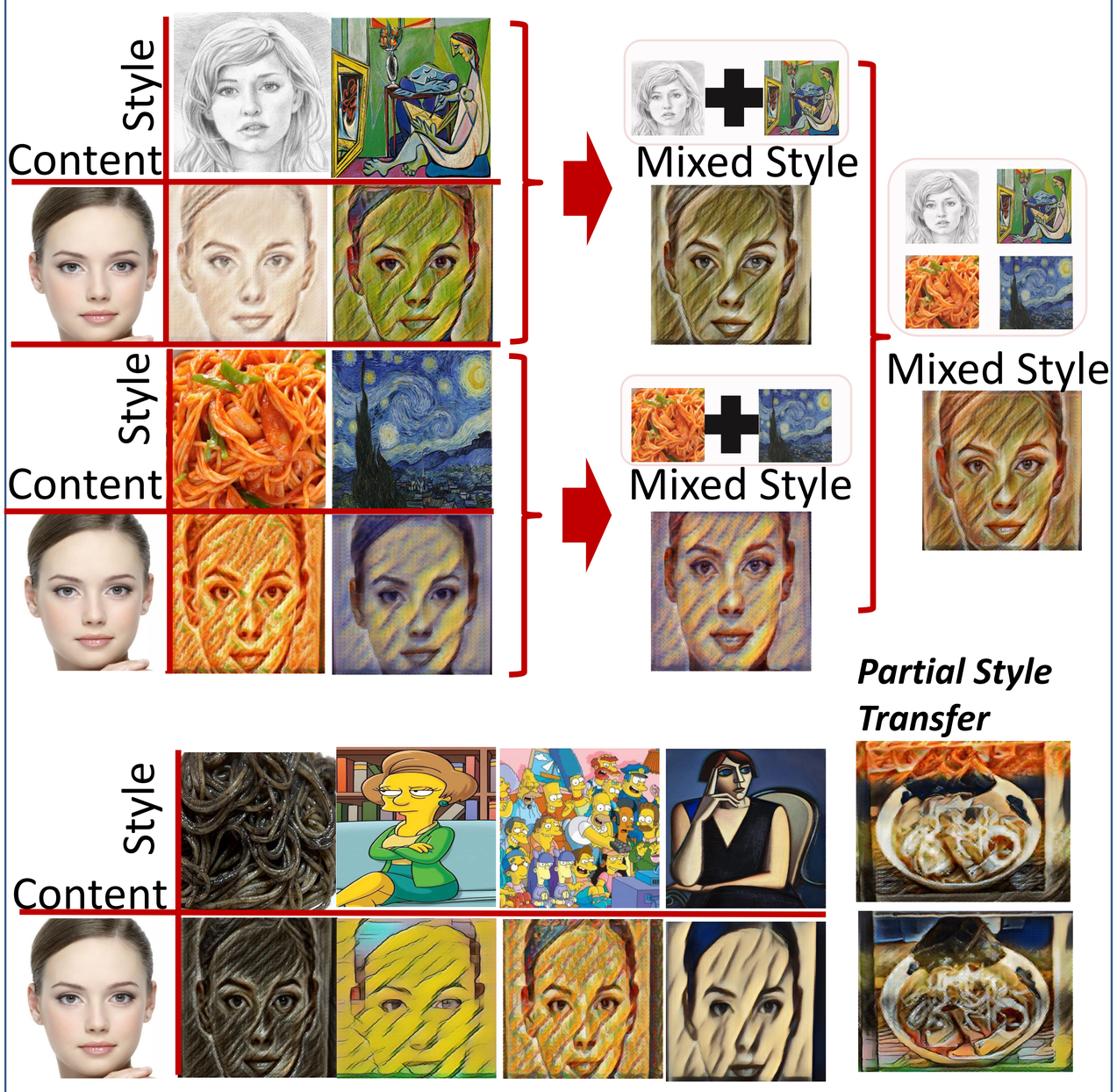


Fig. 2. "Neural style transfer" which creates a novel image by mixing the content and the style of two given images.

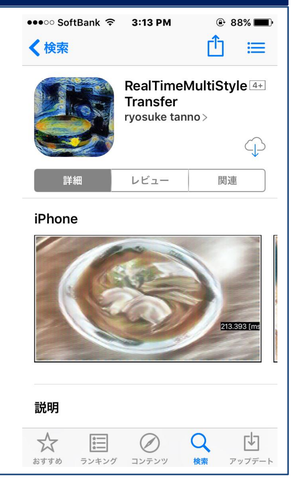


4. Demo Video

5. Multiple Style Transfer App

- ***Multi Style Transfer App (only iOS)***

Down Load
Available on the App Store
https://goo.gl/vmkg2j



- **Recommend only for iPhone 7/6s/SE and iPad Pro**

Reference

[1] J. Johnson et al.: Perceptual Losses for Real-Time Style Transfer and Super-Resolution, ECCV, 2016.
[2] L. A. Gatys et al.: Image style transfer using convolutional neural networks, CVPR, 2016.
[3] S. Iizuka et al.: Let there be Color!: Joint End-to-end Learning of Global and Local Image Priors for Automatic Image Colorization with Simultaneous Classification, SIGGRAPH, 2016.
[4] K. Yanai et al.: Efficient mobile implementation of a cnn-based object recognition system, ACM MM, 2016.
[5]L. A. Gatys et al.: Preserving color in neural artistic style transfer, ArXiv:1606.05897, 2016.