Automatic Motion-blurred Hand Matting for Human Soft Segmentation in Videos

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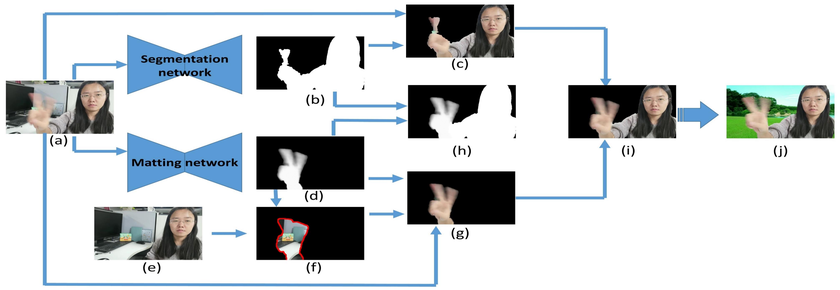
Introduction

Human segmentation technology is very useful in many video or image editing applications. It helps users to change background and brings users a lot of fun. Many excellent image segmentation networks, such as FCN, SegNet, U-Net, and Deeplab can be used for human segmentation. However, these segmentation methods can't deal with motion-blurred hands, which are very common in practical applications. In this paper, we propose a method to deal with human frames with motion-blurred hands. Two short GIF demos of the proposed method are shown in the following.

The flow chart of our method



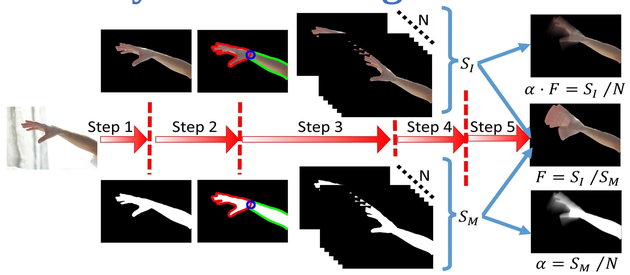
Firstly we segment human by Deeplab v3+ [1],

Then we employ matting network to extract the motion-blurred hand.

Finally, we combine these two kinds of results to generate our final human soft segmentations.

[1] L.-C. Chen, Y. Zhu, G. Papandreou, F. Schroff, and H. Adam, "Encoder-decoder with atrous separable convolution for semantic image segmentation," in *ECCV*, 2018, pp. 833–851.

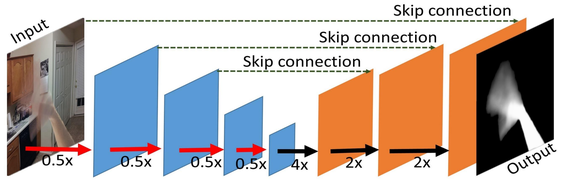
Synthetic data generation



Because it is very difficult to obtain the groundtruth alpha mattes of real motion-blurred hand images, we employ synthetic dataset for training.

We generate synthetic motion-blurred hand images by rotating wrist, elbows, and shoulders. In the above flow chart, we take rotating wrist as an example to introduce each step of our method. N denotes the number of new generated hand images; S_I and S_M denote the sum of new generated hand images and hand masks; α and F denote synthetic alpha matte and hand foreground; motion-blurred hand is calculated by $\alpha \cdot F$.

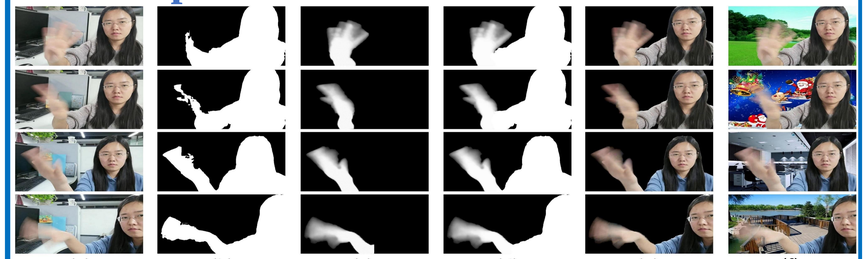
Motion-blurred hand matting network



We employ Xception[2]-based encoder-decoder network for motion-blurred hand matting. The encoder contains 4 downsampling steps. The decoder contains 3 upsampling steps. In each upsampling steps, skip connection is used to recover spatial information.

[2] F. Chollet. "Xception: deep learning with depthwise separable convolutions," in CVPR, 2017, pp. 1800-1807.

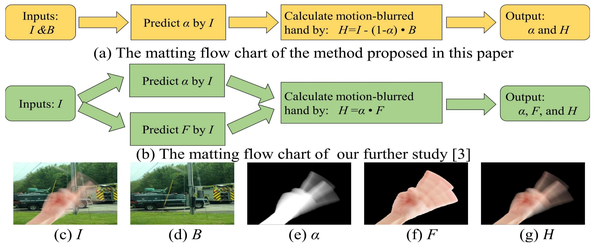
Experimental results on real videos



We can see that human segmentation results in (b) are bad around motion-blurred hands. This problem is successfully solved by our method.

(a) Original frames. (b) Human segmentation results of Deeplab v3+ .
(c) Alpha mattes of motion-blurred hands predicted by matting network.
(d) Human soft segmentation results of the proposed method.
(e) The extracted humans with semi-transparent motion-blurred hands.
(f) New frames with new backgrounds.

Further study



The method proposed in this paper needs background images, which are inconvenient to obtain. In our further study, we propose a method which can extract motion-blurred hand from a single image [3]. In this figure, I denotes original image, B denotes background image, α denotes alpha matte, F denotes foreground image, H denotes the extracted motion-blurred hand.

[3] X. Zhao and Y. Wu, "Automatically Extract Semi-transparent Motion-blurred Hand from a Single Image," in IEEE Signal Processing Letters. doi: 10.1109/LSP.2019.2939754