Interactive Segmentation for Manga

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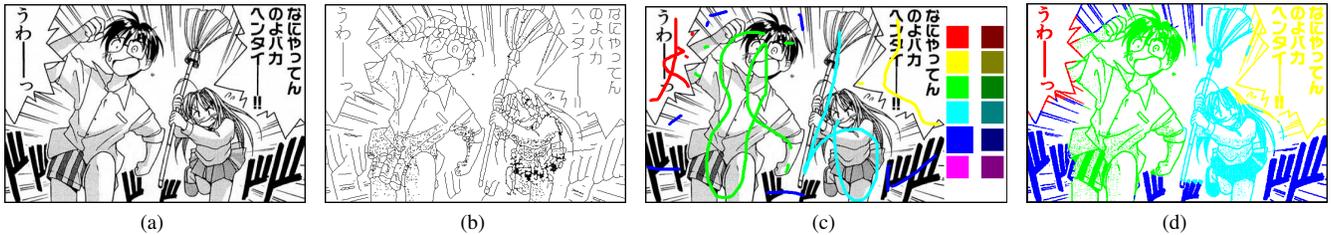
Figure 1: (a) *Source manga image.* (b) *Thinned and vectorized image.* (c) *After selecting a label by specifying color palettes, the user draws scribbles with the label over the image.* (d) *Segmented result.* ©*Ken Akamatsu "Love Hina"*

1 Introduction

There are only a few effective segmentation methods designed for line drawings. Smart Scribbles [Noris et al. 2012] is one of the state-of-the-art interactive segmentation methods for line drawings. However, it can accept only a vector image composed of a relatively small number of strokes with temporal information. Therefore it is hard to apply Smart Scribbles directly to *manga* images because they are raster images with a lot of strokes and without temporal information. We propose a method for interactively segmenting manga images. The proposed method consists of (1) vectorization, (2) labeling and (3) rasterization, and it enables users to segment a complicated manga images by simpler operations than Smart Scribbles and Adobe Photoshop®.

2 Our Approach

Vectorization   Because manga images are provided in the form of raster images, we first need to vectorize them for the next labeling step. Given a binary manga image (Figure 1(a)), we apply *lossless thinning*, in which a thinned image and a *thinning direction map* are constructed. The thinned image is composed of lines in one-pixel thickness. Each pixel of the thinning direction map has the direction to which black pixels shrink in the thinning process. Next, the thinned image is vectorized by considering the connectivity of thinned lines (Figure 1(b)).

Labeling   After vectorizing the image, a user draws scribbles with object ID labels over the source image (Figure 1(c)). Note the source (not thinned) image is shown to the user but it has the vectorized lines internally, and the labeling is applied to the vectorized lines. For labeling, we assign (1) the label of the nearest scribble to all the line segments close to the scribble, and (2) the label produced by Smart Scribbles to the remaining line segments. The threshold of the distance is dynamically and adaptively decided by the number of labels and the number of the unlabeled line segments. Compared to applying Smart Scribbles directly, this drastically reduces the computational cost and achieves real-time selection [1].

Rasterization   Finally, we convert the labeled vector image back to a raster image. Since the labels are assigned to all the line segments by our labeling process, we trace back the thinning process by using our thinning direction map and transfer the labels to the unlabeled regions. As a result, all the pixels can be correctly labeled even though there are some black-painted regions, e.g., the head of the boy (Figure 1(d)).

3 Experiment

We conducted a user study comparing our method to Adobe Photoshop's Quick Selection Tool assuming users prefer easier operation. In the test, ground truth segmentations of six images were shown to four participants, and they were asked to segment the images so as to produce the same segmentation as the ground truth without time constraint. As shown in Figure 2, our method performed more precisely than the Quick Selection Tool in almost the same time. Note that the results using Smart Scribbles are omitted bacause it was much slower than the other two approaches.
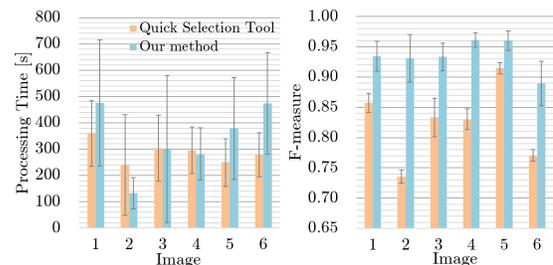

Figure 2: *Processing time and segmentation accuracy in terms of F-measure. F-measure is based on the number of the pixels in the output with the same label as in the ground truth.*

4 Conclusion

We proposed a method for segmenting manga images interactively, which consists of vectorization, labeling, and rasterization. We verified that the proposed method is more accurate than the Quick Selection Tool of Adobe Photoshop in almost the same time.

References

NORIS, G., SỲKORA, D., SHAMIR, A., COROS, S., WHITED, B., SIMMONS, M., HORNUNG, A., GROSS, M., AND SUMNER, R. 2012. Smart scribbles for sketch segmentation. In *Computer Graphics Forum*, vol. 31, 2516–2527.

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[1] For example, even after vectorizing a 800x400 manga image, the original Smart Scribbles to the image takes 8.6 [s] for one scribble.