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Hand segmentation using Deep learning for Computer Assisted Surgery

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***Abstract*— Tracking the surgical instruments and hand is essential part of computer assisted surgery. However, due to the complex background, it is difficult to accurately segment the hand in the surgical images. In this study, we propose the deep learning algorithm which improve the segmentation results for hand tracking.**

I. INTRODUCTION

In computer assisted surgery, surgical instrument pose estimation is an essential. Additionally, hand tracking is also essential because the surgical instruments are partially occluded by the hand during surgery [1]. However, due to blood or complex background tissues, hand segmentation is a difficult task [2]. In this study, we modified U-Net to improve the performance of hand segmentation.

II. METHODS

In order to improve the performance of hand segmentation, Resnet34 pre-trained by ImageNet was used as an encoder. In the decoder part, expansive path of U-Net was used [3]. A skip connection is used for the encoder and decoder, and a residual block is added to the decoder part. Figure 1 shows the architecture of our deep learning network.

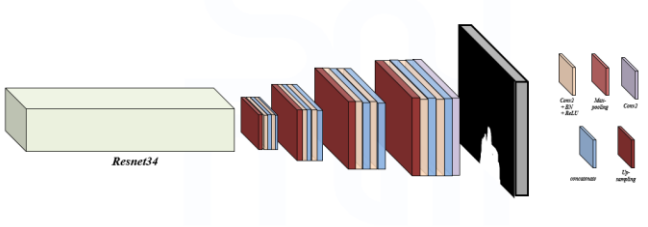

Figure 1. The architecture of our network.

Two types of dataset were used for training: public dataset(HOF, EYTH) and surgical images. First, we trained the network using the public dataset. A total of 4658 images were used for training by augmentation using horizontal flip, vertical flip, rotation and shift. Then, 2448 surgical images acquired by augmentation were additionally used for training. The image size was 256x256, and 80% of the entire dataset was used as train data and 20% as test data.

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III. RESULTS

Evaluation was performed using dice similarity coefficients (DSC) between the ground truth and the predicted hand segmentation. The mean DSCs of hand segmentation was 0.94±0.08. Figure 2 shows the example of the prediction results.

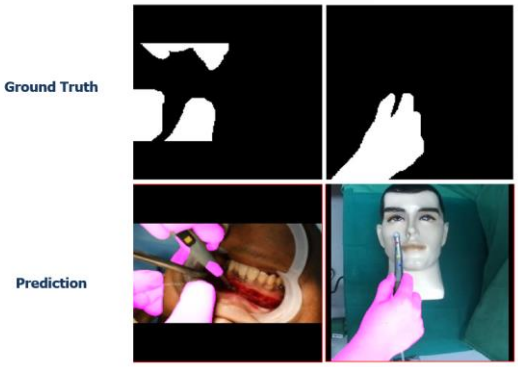

Figure 2. The example of the prediction results

IV. DISCUSSION & CONCLUSION

The accuracy for the entire image was 0.94, which showed high accuracy, however it showed low accuracy of 0.91 for images with complex backgrounds. In the future study, hand tracking using the segmentation results will be performed.

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