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CNN Based Organ Segmentation on Chest Radiograph using Synthetic X-ray Image Reconstructed from MDCT

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INTRODUCTION

- Examining the general literatures on the organ segmentation of structural shapes in chest radiograph, it is shown that the segmented boundary is divided based on the strong image contrast (Fig. 1, Fig. 2).
- Although the criteria to perform the segmentation will be different for each study, it is necessary to have a question on the anatomical realm of segmented organs in CADs. Therefore, in this study, the novel method for finding a real anatomical area in the chest radiograph is investigated with supervised learning-based convolutional neural network (CNN).

AIM

- Developing a CNN based anatomically precise organ segmentation model on chest radiograph using Synthetic X-ray image is the goal.

METHOD

- The 'Gold Standard' label is drawn on the axial plane of the multi-detector CT(MDCT) by radiation oncologists. MDCT images are reconstructed to 'Synthetic X-ray' image using projection based method. Totally, 1175 synthetic X-ray images are used as training and verification data (SNUH IRB approved data).
- The evaluation of Segmentation performance in synthetic chest X-ray images was performed quantitatively by 'Dice-coefficient', but in chest radiograph, qualitative evaluation was carried out through probability map.

RESULTS

Figure 1. Organ segmentation on chest radiograph using traditional algorithms. (a) input X-ray image (b) segmentation result by K-means clustering method and (c) segmentation result by maximum entropy thresholding method.

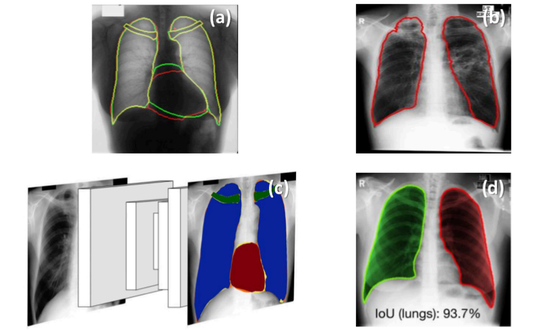

Figure 2. Organ segmentation results on chest radiograph using various algorithms. (a) CNN based model: 'InvertedNet'[1] (b) Graphcut based model[2] (c) CNN based model: 'X-Net+'[3] and (d) GAN based model: 'SCAN'[4]

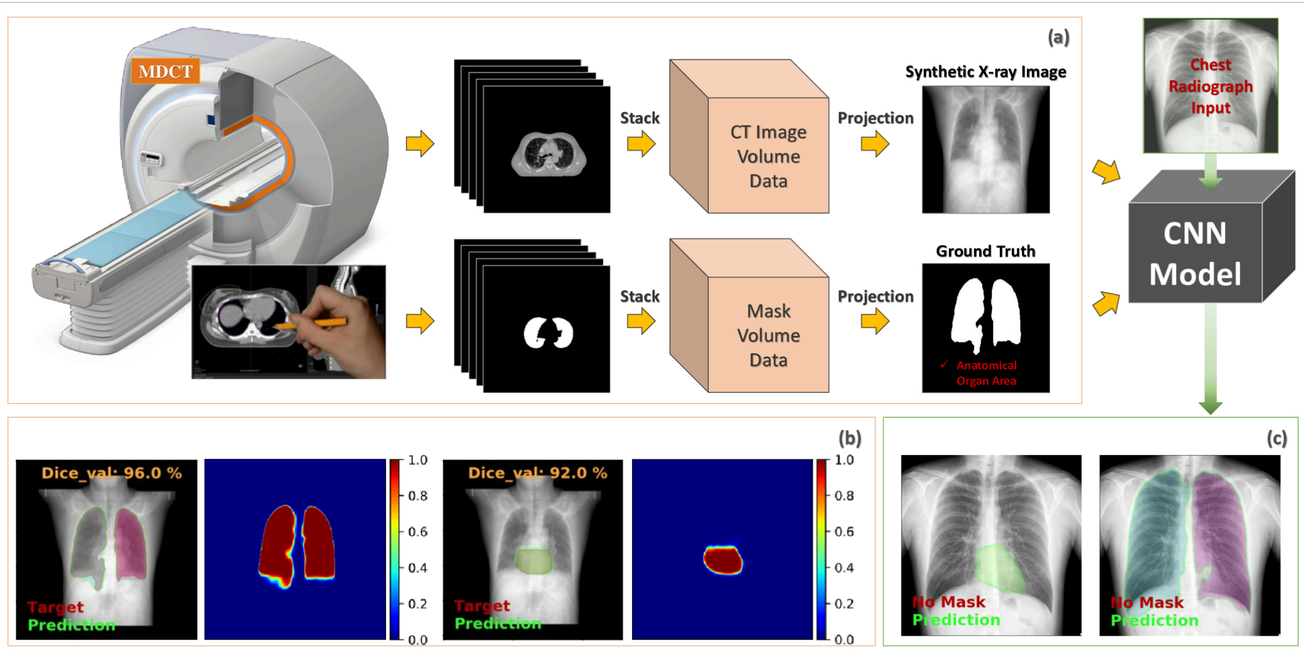

Figure 3. (a) Reconstruction procedure of synthetic X-ray image using multidetector CT images, (b) validation for segmentation on synthetic X-ray image and (c) test for segmentation on chest radiograph.

CONCLUSIONS

- Organ segmentation can be implemented in chest radiograph using CNN model trained with the synthetic X-ray images generated from MDCT data.
- Developed prediction model could segment actual spatial region of organs from chest radiograph. It can be directly applied to the diagnosis of suspected abnormal organ diseases and also indirectly be used to increase the probability of detection of hidden pulmonary nodules (or COVID19 disease) by including substantial areas of the obscured lungs that could almost be missed.

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