World Academy of Science, Engineering and Technology
International Journal of Health and Medical Engineering
Vol:12, No:09, 2018

Content-Aware Image Augmentation for Medical Imaging Applications

Authors : Filip Rusak, Yulia Arzhaeva, Dadong Wang

Abstract : Machine learning based Computer-Aided Diagnosis (CAD) is gaining much popularity in medical imaging and diagnostic radiology. However, it requires a large amount of high quality and labeled training image datasets. The training images may come from different sources and be acquired from different radiography machines produced by different manufacturers, digital or digitized copies of film radiographs, with various sizes as well as different pixel intensity distributions. In this paper, a content-aware image augmentation method is presented to deal with these variations. The results of the proposed method have been validated graphically by plotting the removed and added seams of pixels on original images. Two different chest X-ray (CXR) datasets are used in the experiments. The CXRs in the datasets defer in size, some are digital CXRs while the others are digitized from analog CXR films. With the proposed content-aware augmentation method, the Seam Carving algorithm is employed to resize CXRs and the corresponding labels in the form of image masks, followed by histogram matching used to normalize the pixel intensities of digital radiography, based on the pixel intensity values of digitized radiographs. We implemented the algorithms, resized the well-known Montgomery dataset, to the size of the most frequently used Japanese Society of Radiological Technology (JSRT) dataset and normalized our digital CXRs for testing. This work resulted in the unified off-the-shelf CXR dataset composed of radiographs included in both, Montgomery and JSRT datasets. The experimental results show that even though the amount of augmentation is large, our algorithm can preserve the important information in lung fields, local structures, and global visual effect adequately. The proposed method can be used to augment training and testing image data sets so that the trained machine learning model can be used to process CXRs from various sources, and it can be potentially used broadly in any medical imaging applications.

Keywords : computer-aided diagnosis, image augmentation, lung segmentation, medical imaging, seam carving
Conference Title : ICRMI 2018 : International Conference on Radiology and Medical Imaging
Conference Location : London, United Kingdom
Conference Dates : September 27-28, 2018