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Medical Image Augmentation Using Spatial Transformations for Convolutional Neural Network

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Abstract : The lack of data is a pain problem in medical image analysis using a convolutional neural network (CNN). This work uses various spatial transformation techniques to address the medical image augmentation issue for knee detection and localization using an enhanced single shot detector (SSD) network. The spatial transforms like a negative, histogram equalization, power law, sharpening, averaging, gaussian blurring, etc. help to generate more samples, serve as pre-processing methods, and highlight the features of interest. The experimentation is done on the OpenKnee dataset which is a collection of knee images from the openly available online sources. The CNN called enhanced single shot detector (SSD) is utilized for the detection and localization of the knee joint from a given X-ray image. It is an enhanced version of the famous SSD network and is modified in such a way that it will reduce the number of prediction boxes at the output side. It consists of a classification network (VGGNET) and an auxiliary detection network. The performance is measured in mean average precision (mAP), and 99.96% mAP is achieved using the proposed enhanced SSD with spatial transformations. It is also seen that the localization boundary is comparatively more refined and closer to the ground truth in spatial augmentation and gives better detection and localization of knee joints.

Keywords : data augmentation, enhanced SSD, knee detection and localization, medical image analysis, openKnee, Spatial transformations
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