Covid-19 X-ray Image Augmentation using Spatial Transformations

Shubham Chaudhari, Trupti Chavan, Vmvijayayuvaram Singh, Guda Ramachandra Kaladhara Sarma, Kameshwar Rao JV,

The lack of data is a major problem in medical image understanding using convolutional neural network (CNN). In this work, we have used the spatial transforms like negative, histogram equalization, power law, sharpening, averaging, gaussian blurring, etc. to address the medical image augmentation issue for detection of Covid-19 from X-ray images. These augmentations help to generate more samples, serve as pre-processing methods and highlight the features of interest. The experimentation is done on the Covid-19 dataset [1] which is a collection of Chest X-ray images of COVID-19 cases. To detect COVID-19 class, Densenet-121 model is used. We have shortlisted average, image sharpening and power law as the more suitable augmentations. The average transformation is a traditional augmentation method and is the mean of the pixels over $n \times n$ image mask. To generate images with more low frequencies, different mask sizes of (3 and 5) are considered. The image sharpening is the addition of high frequency and original image and helps to enhance the high frequencies like edges which may not be visible in poor quality images. To generate the high frequency images, various techniques (such as Laplacian mask, canny edge detector, Sobel filter and subtraction of smoothed image from original) are used. The power law transformation manipulates the contrast of an image, performs calibration and is useful to ease the detection of fractures. It is computed by taking the gamma power of image intensities. In this work, various gamma values are used in the range 0.4-0.6 and number of images are generated. The sample images generated after augmentation are shown in Figure 1.
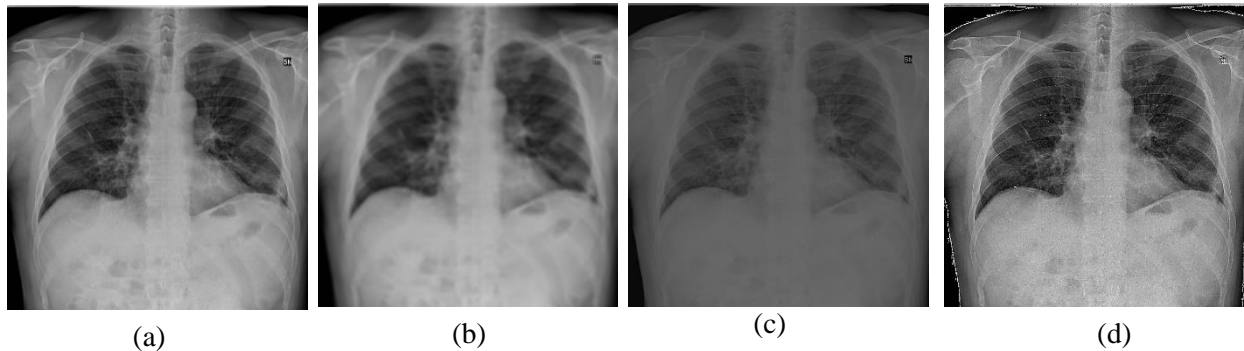

(a) (b) (c) (d)

Figure 1: (a) Original image, (b) Average, (c) Power law and (d) Image sharpening

The results obtained using these augmentation techniques on COVID-19 X-ray image dataset are given in Table 1:

Sr. No.	Augmentation Technique	Train Set	No. of Augmented Covid-19 images in train Set	Validation Set	Validation loss	Validation Accuracy
1	Original Set of Covid-19 X-ray [1]	98	0	50	0.34	92
2	Average mask	480	204	50	0.2	96
3	Image sharpening	480	204	50	0.23	92
4	Power law (5 gamma values)	576	255	50	0.1854	94
5	Average mask (2 kernels), sharpening (2 types) and Power law (5 gamma values) - Augmentations with selected images from above	1032	459	50	0.21	94

References:

1. Covid-19 Chest X-ray Dataset: https://github.com/ieee8023/covid-chestxray-dataset