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Generating Synthetic Chest X-ray Images for Improved COVID-19 Detection Using Generative Adversarial Networks

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Abstract : Deep learning plays a crucial role in identifying COVID-19 and preventing its spread. To improve the accuracy of COVID-19 diagnoses, it is important to have access to a sufficient number of training images of CXRs (chest X-rays) depicting the disease. However, there is currently a shortage of such images. To address this issue, this paper introduces COVID-19 GAN, a model that uses generative adversarial networks (GANs) to generate realistic CXR images of COVID-19, which can be used to train identification models. Initially, a generator model is created that uses digressive channels to generate images of CXR scans for COVID-19. To differentiate between real and fake disease images, an efficient discriminator is developed by combining the dense connectivity strategy and instance normalization. This approach makes use of their feature extraction capabilities on CXR hazy areas. Lastly, the deep regret gradient penalty technique is utilized to ensure stable training of the model. With the use of 4,062 grape leaf disease images, the Leaf GAN model successfully produces 8,124 COVID-19 CXR images. The COVID-19 GAN model produces COVID-19 CXR images that outperform DCGAN and WGAN in terms of the Fréchet inception distance. Experimental findings suggest that the COVID-19 GAN-generated CXR images possess noticeable haziness, offering a promising approach to address the limited training data available for COVID-19 model training. When the dataset was expanded, CNN-based classification models outperformed other models, yielding higher accuracy rates than those of the initial dataset and other augmentation techniques. Among these models, ImagNet exhibited the best recognition accuracy of 99.70% on the testing set. These findings suggest that the proposed augmentation method is a solution to address overfitting issues in disease identification and can enhance identification accuracy effectively.

Keywords : classification, deep learning, medical images, CXR, GAN.
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