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Cycle Generative Adversarial Network Approaches To Produce Novel Portable Chest X-ray Images For COVID-19 Diagnosis

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Abstract

COVID-19, declared a global pandemic by the World Health Organization, mainly affects the pulmonary tissues, playing chest X-ray images an important role for its screening and early detection. In this work, given the low availability of images of this recent disease, we present new approaches to artificially increase the dimensionality of portable chest X-ray datasets for COVID-19 diagnosis. Despite the poor quality of the portable X-ray images, we provide an overall accuracy of 92.50 % in a COVID-19 screening, proving the suitability of this proposal for COVID-19 diagnostic tasks.

Introduction

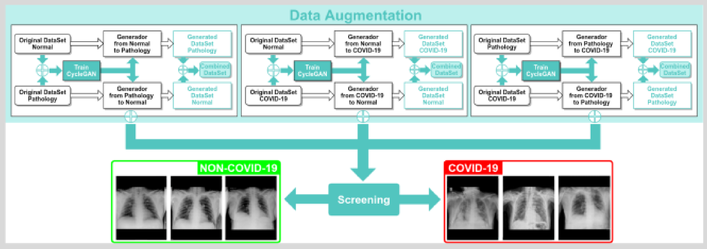
Chest X-ray imaging is an image modality widely used to diagnose common pulmonary pathologies.

Portable chest X-ray devices are recommended to reduce the risk of cross contamination.

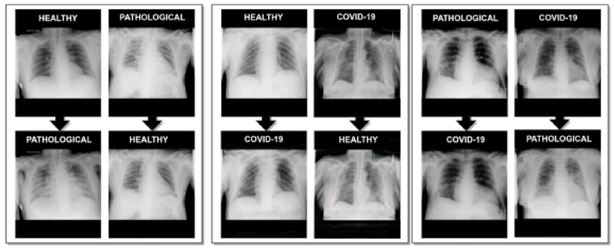
COVID-19 is a highly infectious disease that has caused more than 136 million cases as well as more than 2.94 deaths worldwide.

Data scarcity is a common problem in many medical imaging domains. It is even more critical for this particular case, as the disease is very recent.

Methodology



Generated synthetic images



Results

Dataset

The dataset is composed of 600 images provided by the Complexo Hospitalario Universitario de A Coruña (CHUAC) with 200 healthy cases, 200 pathological cases and 200 COVID-19 cases.

Experiments

The first 3 experiments validate the separability among generated images. A fourth experiment was conducted to separate COVID-19 from NON COVID-19 in the augmented dataset.

First experiment

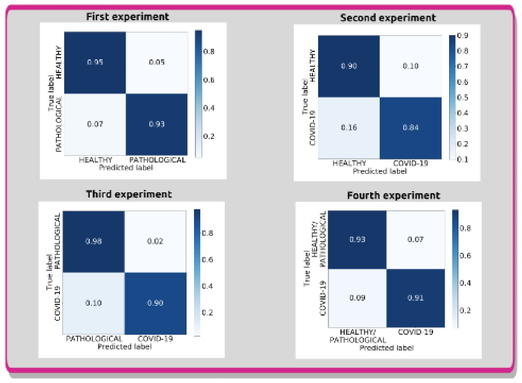
Cases	Precision	Recall	F1-Score
Healthy	0.92	0.95	0.94
Pathological	0.95	0.93	0.94

Second experiment

Cases	Precision	Recall	F1-Score
Healthy	0.84	0.90	0.87
COVID-19	0.90	0.84	0.87

Third experiment

Cases	Precision	Recall	F1-Score
Pathological	0.91	0.98	0.94
COVID-19	0.97	0.90	0.93



Conclusions

- Fully and automatic approaches to artificially increase the size of a chest X-ray dataset used for COVID-19 diagnosis.
- The CycleGAN was used to generate synthetic images in 3 complementary scenarios.
- The original dataset is augmented with a novel set of useful and relevant synthetic images, representative of the great domain variability.
- Satisfactory results were obtained despite the low quality and lack of details of the portable acquisition devices used to obtain the input dataset.
- These ideas could be extrapolated to other pulmonary pathologies and even other medical imaging domains.

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