

# Analysis of Separability of COVID-19 and Pneumonia in Chest X-ray Images by Means of Convolutional Neural Networks <sup>†</sup>

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**Abstract:** The new coronavirus (COVID-19) is a disease that is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). On 11 March 2020, the coronavirus outbreak has been labelled a global pandemic by the World Health Organization. In this context, chest X-ray imaging has become a remarkably powerful tool for the identification of patients with COVID-19 infections at an early stage when clinical symptoms may be unspecific or sparse. In this work, we propose a complete analysis of separability of COVID-19 and pneumonia in chest X-ray images by means of Convolutional Neural Networks. Satisfactory results were obtained that demonstrated the suitability of the proposed system, improving the efficiency of the medical screening process in the healthcare systems.

**Keywords:** computer-aided diagnosis; chest X-ray imaging; COVID-19; pneumonia; deep learning

## 1. Introduction

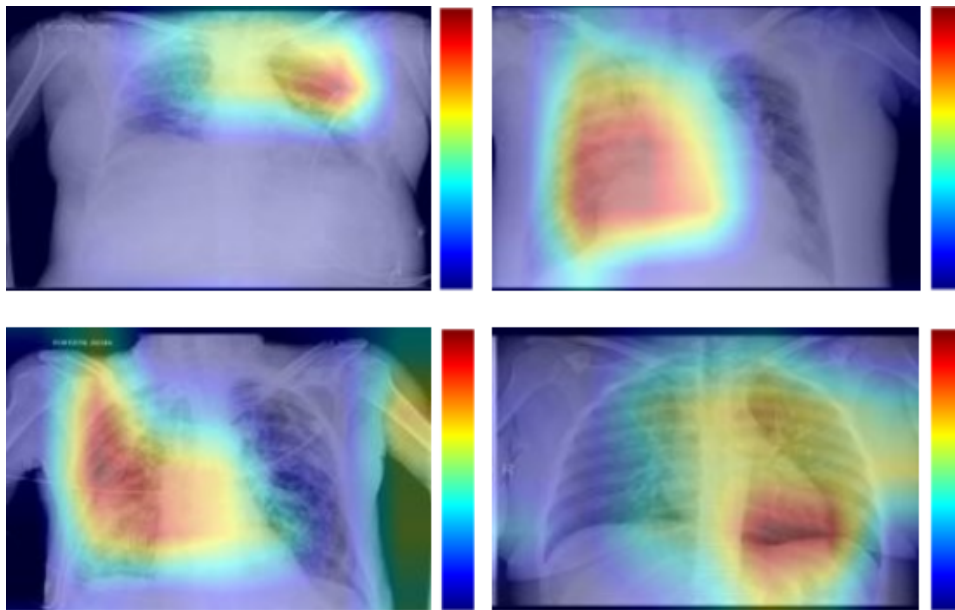
The coronavirus disease 2019 (COVID-19) disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has resulted in an unprecedented public health crisis. This highly infectious disease was first identified in the city of Wuhan in Hubei province, China in December 2019. The number of confirmed cases is more than 7.5 million, affecting more than 213 countries, including 287,399 deaths according to the World Health Organization reports. COVID-19 has rapidly progressed to become a global pandemic, causing an unprecedented impact on the health, social, and economic well-being of people around the world. One of the most effective ways of limiting this relevant pandemic disease is the early, rapid, and accurate diagnosis and treatment of infected patients. In this sense, chest X-ray images are the most common and widely available diagnostic imaging technology, playing a crucial role in clinical care and epidemiological studies of confirmed or suspected of COVID-19 cases.

## 2. Methodology

Thus, in this work, we present a novel fully automatic methodology for the analysis of separability of COVID-19 and pneumonia-infected lungs in chest X-ray images, given the high level of similarity between these two lung diseases. To this end, different complementary deep learning-based approaches that are based on a densely convolutional network architecture are adapted to better analyze the distinctive clinical patterns of these relevant diseases [1].

### 3. Results and Conclusions

We perform different experiments using two publicly available chest X-ray image datasets in order to validate the designed methodology [2,3]. Satisfactory results were obtained that demonstrated the suitability of the proposed methodology to facilitate early diagnosis and, thus, enable support to the clinical decision-making process in this pandemic scenario. Figure 1 show representative examples of graphical representations of heatmaps based on predictions of pathological regions in the chest X-ray images.



**Figure 1.** Results of the proposed methodology for the analysis of separability of COVID-19 and pneumonia-infected lungs in chest X-ray images. 1st row, chest X-ray images from patients infected with pneumonia. 2nd row, chest X-ray images from patients infected with COVID-19.

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**Conflicts of Interest:** The authors declare no conflict of interest.

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