



COVID-19 image classification using deep learning: Advances, challenges and opportunities

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ARTICLE INFO

Index Terms:

COVID-19 detection

Deep learning

Convolutional neural networks

X-ray and CT scan Images

ABSTRACT

Corona Virus Disease-2019 (COVID-19), caused by Severe Acute Respiratory Syndrome-Corona Virus-2 (SARS-CoV-2), is a highly contagious disease that has affected the lives of millions around the world. Chest X-Ray (CXR) and Computed Tomography (CT) imaging modalities are widely used to obtain a fast and accurate diagnosis of COVID-19. However, manual identification of the infection through radio images is extremely challenging because it is time-consuming and highly prone to human errors. Artificial Intelligence (AI)-techniques have shown potential and are being exploited further in the development of automated and accurate solutions for COVID-19 detection. Among AI methodologies, Deep Learning (DL) algorithms, particularly Convolutional Neural Networks (CNN), have gained significant popularity for the classification of COVID-19. This paper summarizes and reviews a number of significant research publications on the DL-based classification of COVID-19 through CXR and CT images. We also present an outline of the current state-of-the-art advances and a critical discussion of open challenges. We conclude our study by enumerating some future directions of research in COVID-19 imaging classification.

1. Introduction

Coronavirus or COVID-19 is a viral disease that was first identified in Wuhan, China, in December 2019 and later spread quickly worldwide [1,2]. It is caused by Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) and has affected millions of people worldwide. COVID-19 infection starts in the throat's mucous membranes and spreads to the lungs through the respiratory tract. COVID-19 is a highly contagious disease; therefore, it is vital to rapidly screen, diagnose and isolate patients to prevent the spread of the disease and accelerate their proper treatment. Diagnosis of COVID-19 infection through medical imaging, such as CXR and CT scans, has been reported to yield accurate results and is being used widely in the screening of the disease [3–5]. However, successful interpretation of results through images faces several challenges due to the very recent development of the disease and similarities

with other pulmonary disorders such as pneumonia [6] (refer to Fig. 1). Due to the complex nature of COVID-19, its accurate diagnosis is a relatively complicated time-taking task that requires the expertise of radiologists to achieve acceptable diagnostic performance.

Control and eradication of COVID-19 depend heavily on isolating the infected and vaccinating the susceptible. At present, the gold standard for COVID-19 detection is the RT-PCR (Reverse Transcription Polymerase Chain Reaction) test; however, it requires more time to process the specimen and generate the result. Also, it has been observed that many patients may test positive for COVID-19 after recovery [7]. Vaccination is known to immunize people against the virus; however, they are still prone to the infection. Developing an effective and safe vaccine with prolonged efficacy is still in progress and will take substantial time. Further, vaccination of the entire global population will also take time due to the constraints on the availability of the vaccine

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<https://doi.org/10.1016/j.combiomed.2022.105350>

Received 15 November 2021; Received in revised form 10 February 2022; Accepted 22 February 2022

Available online 3 March 2022

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