A CNN Based Diagnostic Model Using Chest X-Rays: A Multistage Multiclass Isolated and Developed Transfer Learning Framework

Abstract:

In 2019, a deadly coronaviral infection (COVID-19) that infected millions of people globally was detected in China. This fatal virus affects the respiratory system and currently spreads to more than 200 nations worldwide. COVID-19 may be found using a chest X-ray scan, a reliable imaging method. Although an expert may examine an X-ray scan manually, this process takes a lot of time. Therefore, deep convolutional neural networks (CNNs) may be utilized to automate this procedure. In this work, at the first step, a novel isolated 19-layer CNN model is developed from scratch to detect chest infections using X-rays. Then, the developed model is reutilized to distinguish the type of chest infection, such as COVID-19, Fibrosis, Pneumonia, and Tuberculosis, using the transfer learning approach. Stochastic gradient descent with momentum is utilized to optimize the model. The proposed multistage framework shows 98.85% and 97% classification accuracies for chest infection detection (binary classification between normal and patient) and four-class sub-classification (COVID-19, Fibrosis, Pneumonia, and Tuberculosis) for an online chest X-ray dataset. The reliability of the proposed multistage CNN model was further validated through a new dataset, showing an accuracy of 98.5%. The proposed multistage methodology took minimal training time compared to publicly available pre-trained models. Therefore, the presented multistage deep learning framework can help doctors in clinical practices.