

# **Deep transfer learning network for robust automatic classification of COVID-19, pneumonia, and tuberculosis from X-rays**

## **ABSTRACT**

The global pandemic of coronavirus disease 2019 is continuing to have a significant effect on the well-being of the global population, thus increasing the demand for rapid testing, diagnosis, and treatment. As COVID-19 can cause severe pneumonia, early diagnosis is essential for correct treatment, as well as to reduce the stress on the healthcare system. Along with COVID-19, other etiologies of pneumonia and Tuberculosis (TB) constitute additional challenges to the medical system. Chest X-ray (CXR) and computed tomography (CT) scans are the primary imaging modalities for diagnosing respiratory diseases. The objective of this work is to develop a new deep transfer learning pipeline, named DenResCov-19, to diagnose patients with COVID-19, pneumonia, TB or healthy based on CXR images. The pipeline consists of the existing DenseNet-121 and the ResNet-50 networks. Since the DenseNet and ResNet have orthogonal performances in some instances, in the proposed model we have created an extra layer with convolutional neural network (CNN) blocks to join these two models together to establish superior performance as compared to the two individual networks. We have tested the performance of our proposed network on two-class (pneumonia and healthy), three-class (COVID-19 positive, healthy, and pneumonia), as well as four-class (COVID-19 positive, healthy, TB, and pneumonia) classification problems. We have validated that our proposed network has been able to successfully classify these lung-diseases on our four datasets and this is one of our novel findings.