Chapter 7
Evaluating VGG16, ResNet50, and Xception for COVID-19 Detection via a Web-Based Deep Learning Interface

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ABSTRACT

The global outbreak of COVID-19 has emphasized the need for fast and accurate diagnostic methods, especially in areas where advanced testing facilities are scarce or unavailable. This research proposes a deep learning-based method for the binary classification of chest X-ray images aimed at detecting COVID-19 infections. We evaluate and compare the performance of three prominent Convolutional Neural Network (CNN) architectures ResNet50, VGG16, and Xception trained on publicly available chest radiograph datasets. Additionally, a confusion matrix, training versus

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validation accuracy plots, and the ROC curve are employed to gain deeper insights into the model's effectiveness and diagnostic capability. To enhance usability, a user-friendly web interface has also been developed, enabling users to upload images and obtain real-time classification results. Experimental findings indicate that all three models perform well in distinguishing COVID-19 cases, with the Xception model achieving the highest accuracy.

I. INTRODUCTION

COVID-19 created a worldwide public health emergency and as a result there was urgent need for cost-efficient, reliable, and scalable ways of diagnosing patients with this disease and the rest of the population as well. RT-PCR (Reverse Transcriptase-Polymerase Chain Reaction Testing) is currently regarded as the gold standard diagnostic test for diagnosing COVID-19. However, RT-PCR has many limitations, such as being expensive, having limited access to patients, and providing a delay in obtaining results.

The application of Deep Learning, particularly Convolutional Neural Networks (CNNs), to automated medical image analysis, has made significant advances in the ability of medical professionals to quickly identify patterns in large amounts of medical images. CNNs learn the features of a medical image just from the pixels of the image. CNN's ability to learn the image features has made it possible for medical professionals to use them to classify images into many categories. It has been demonstrated that several types of pre-trained CNN networks have a high degree of accuracy when classifying images in many types of classification tasks, including medical diagnostic images. Many of the CNN networks use Transfer Learning methodology, whereby large data sets of typical images are used to train the models, and then they have been successfully adapted for much smaller medical imaging sets.

In this study we have investigated three widely used CNN architectures to perform binary classification tasks on chest X-rays by identifying COVID-19 positive cases from COVID-19 negative cases. Additionally, a web-based application developed using Django has been created for easy upload of chest X-ray images by health care workers or researchers and to receive instant diagnostic results for their uploaded chest X-ray images. Incorporating trained deep neural networks into a web server backend facilitates the efficient completion of inference and reporting results.

The primary goals of this work are:

1. To evaluate and compare the classification accuracies of three commonly used CNN architectures for detecting COVID-19; and