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The Diagnosis of COVID-19 by Means of Transfer Learning through X-ray Images

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Abstract: Radiography is used in medical treatment as a method to diagnose the internal organs of the human body from diseases. However, the advancement in machine learning technologies have paved way to new possibilities of diagnosing diseases from chest X-ray images. One such diseases that are able to be detected by using X-ray is the COVID-19 coronavirus. This research investigates the diagnosis of COVID-19 through X-ray images by using transfer learning and fine-tuning of the fully connected layer. Hyperparameters such as dropout, *p,* number of neurons, and activation functions are investigated on which combinations of these hyperparameters will yield the highest classification accuracy model. VGG19 learning model created by the Visual Geometry Group is used for extraction of features from the patient's chest X-ray images. To evaluate the combination of various pipelines, the loss and accuracy graphs are used to find the pipeline which performs the best in classification task. The findings in this research will open new possibilities in screening method for COVID-19.

Keywords: **Transfer learning, VGG19, hyperparameter, optimization, fully connected layer**

1. INTRODUCTION

The COVID-19 virus still runs rampant in our communities, causing sickness and deaths. The severe acute coronavirus 2 respiratory syndrome (SARS-CoV-2), also known as COVID-19 coronavirus is believed to originated from zoonotic source in China's Hubei Province in early December 2019 [1]. Since then, the virus still spreads in our society and the World Health Organization (WHO) reported 171,292,827 confirmed cases including 3,687,589 deaths due to COVID-19 as of 3 June 2021 [2]. The most common test kits for COVID-19 are polymerase chain reaction (RT-PCR) assays intended to genetically identify SARS-CoV-2. However, test kits supply availability, waiting time and the possibility of false negative or positive results are the disadvantages of rapid test kits. Alternative diagnosis method has been demonstrated in Hubei where patients undergo computed tomography (CT) scans for COVID-19 as the disease have pneumonia like infections in the lungs [3]. Therefore, machine learning solutions can be developed in diagnosing COVID-19 from chest X-ray images.

2. RELATED WORKS

Analysis of the VGG16 model in developing the NCOVnet for fast detection of COVID-19 in X-ray based on deep learning was carried out by Panwar et al. [4]. The authors utilized datasets from open sources. They were 5863 images obtained and were divided into 'Normal', 'Bacteria Pneumonia', and 'Viral Pneumonia' classes. Subsequently, 70% of the data was allocated for training purpose and 30% for testing. VGG16 was used to extract features from the X-ray images. Consequently, the hyperparameter optimized were the learning rate, known epochs, and maximum number of iterations. Overall, the authors stated that the proposed model achieved 88.10% collectively although limited amount of training data.

In contrast to previous studies, Heidari et al. [5] investigated the effects of applying preprocessing algorithms for chest X-ray images in improving the performance of CNN model in prediction of COVID-19. Subsequently, 415 COVID-19 images, 5179 non-COVID-19 pneumonia images, and 2880 normal chest X-ray images were among the 8474 chest X-rays used as dataset for the research. Consequently, two image preprocessing steps were added by the authors which generated a pseudo color image. The authors reported a strong correlation between image processing and classification accuracy. They achieved a 94.5% overall accuracy and a decrease performance when no preprocessing steps with 88% accuracy.

Vaid et al. [6] highlight the deep learning COVID-19 detection bias that is frequently noticed in artificial intelligence accuracy in identifying COVID-19 in chest X-ray pictures. The authors exploited the transfer learning process by utilizing VGG19 to extract features from chest X-ray images. It was crucial that the classification ability of the proposed model to be accurate. Therefore, early stopping and learning rate reduction were applied. Thus, it was reported that the research achieved overall 96.3% classification accuracy. The present study shall attempt to investigate the efficacy of a modified VGG-19 model in which the fully connected

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