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COVID-19 Detection in CT Images using Deep Transfer Learning

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Abstract: Confronting the COVID-19 pandemic introduced by the newest coronavirus, SARS-CoV-2, is one of the human species' most significant problems today. The fast identification and isolation of infected patients is a crucial factor in slowing down the spread of the virus. The Reverse Transcription Polymerase Chain Reaction (RT-PCR) process, one of the primary methods for COVID-19 recognition, is time-consuming in addition short-lived due to the pandemic. Deep learning applied to patients' CT images has given away encouraging results popular the identification of COVID-19 in this context. The powerful net family of CNN models using CT images to perform COVID-19 recognition is suggested in this article by VGG-16. Consequently, COVID-19 detection was proposed as a VGG-16 model with an overall accuracy of 98.33 percent. We assume that the published figures reflect modern outcomes in terms of productivity and efficiency.

Keywords: VGG-16, Deep learning, CT images, Convolution neural networks (CNN)

1. Introduction

The coronavirus epidemic continues to take the planet by surprise. Conferring to the latest World Health Organization (WHO) updates, over one million people in 200 countries have been affected to date [1]. Approximately ninety thousand accepted demises are registered in desperation to the situations. Throughout history, humanity has not encountered a comprehensive that spreads quickly worldwide.

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If a variety of new viruses can advance from individual to individual while easily affecting interactions continuously and successfully, it is termed a pandemic. The recent coronavirus (2019-nCoV) follows both definitions [2]. The first birth of the coronavirus was identified in Wuhan City, China, at the edge of 2019. Today, its deadly consequences threaten the entire world, from Europe to America. On 11 February 2020, the WHO titled the 2019-nCoV infectious situation coronavirus disease 2019 (COVID-19). 2019-nCoV is a recent type of the coronavirus family of Serious Acute Respiratory Syndrome (SARS-CoV) and is called SARS-CoV-2. Fig.1 displays the 3D view of the pharmaceutical illustrating depicting the form of the coronavirus. Because of this, it is clear that recent identification of COVID-19 is important to disrupt the transmission of COVID-19 and to avert the effect of close contact through early patient isolation, trace and quarantine. A crucial component of disease control is effectively monitoring disease progression in patients with COVID-19. At the same time, pharmaceutical imaging modalities such as chest X-ray and CT are not suggested to be used for early recognition of COVID-19 in Canada.

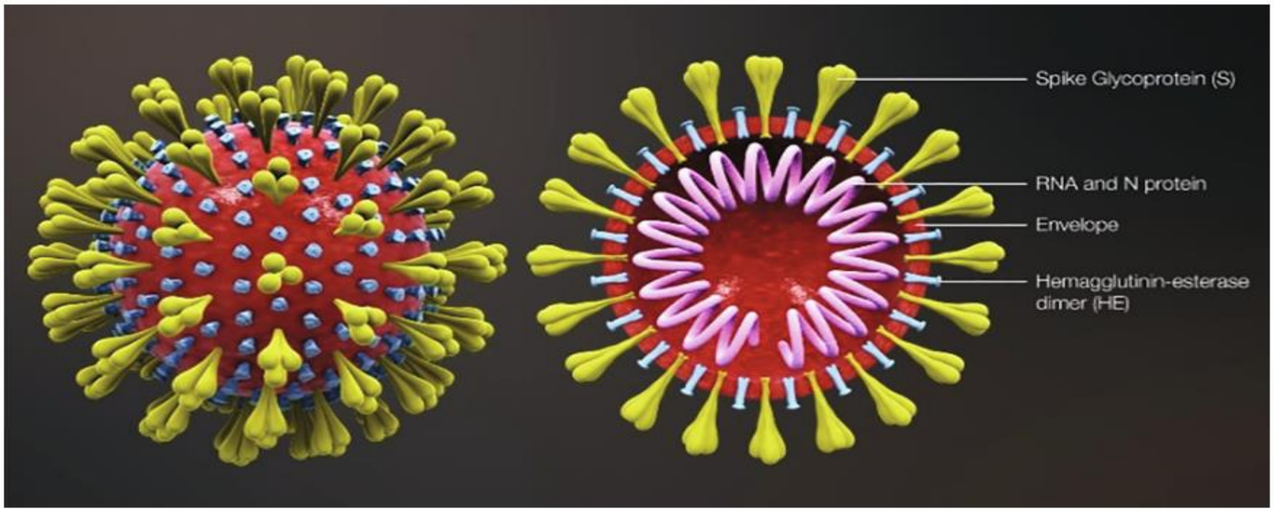

Fig. 1: 3D view of the medical image of the corona virus

They play a strong aspect in identifying the analysis of positive COVID-19 pneumonia as glowing as tracking ailment level [3-4]. These types of pictures show the magnitude of abnormal ground-glass opacities that increase heavily after the onset of COVID-19 symptoms.

2. Literature Review

An approach to automatically classify and identify decease with CT images of COVID-19 patients is defined in [5] by Shan et al. The recognized dataset consists of 549 CT corona images. In [6], the authors proposed the CNN and advanced early-trained AlexNet based on the created CT scan and X-rays analysis dataset. The observations' results show that using the updated CNN, the illustrations used can deliver accuracy of up to 98 percent through a pre-trained system and 94.1 percent precision. Models focused on unfathomable culture machine learning used for COVID-19 CT image arrangement [7-9]. This article aims to describe a model of unfathomable culture for COVID-19 recognition and screening. Recently, automated COVID-19 CAD employing radiology illustrations has gained several scholars' interest and many methods have been implemented in the literature. Butt with el. [10] Scientifically, different CNN models have been studied and a miniature with a mixture of 2D and 3D CNN structures has been suggested for recognition of CT pictures obsessed by COVID-19, affecting virus-related situations, or else no decrease. The method gets 98.2 percent awareness and 92.2 percent precision. The employment of unfathomable culture trendy COVID-19 recognition consuming CT illustrations was proposed by Ozturk et al. [11]. The authors tested ten pre-trained CNN models: ResNet-18, VGG-19, Xception, AlexNet, ResNet-50, SqueezeNet, VGG-16, GoogleNet, ResNet-101 and MobileNet-V2. The experimental findings present that ResNet101 achieved best in 194 patients with an AUC of 0.99 concluded 1020 CT illustrations. Thus, ResNet50, Initiation V3 and Inception-ResNetV2 were applied by Domingues et al. [12], using transference culture to categorize X-ray illustrations towards regular then COVID-19 modules. With ResNet50, this approach accomplishes good output with an efficiency of 98 percent. However, the amount of X-ray illustrations is only 100 and illustrations are very low. Wang et al. [13] suggested an accessible source COVID-Net design occupying the architecture pattern of projection-expansion projection to recognize COVID-19 situations after X-ray illustrations. The authors registered an efficiency of 92.6 percent in this study. Oh et al. [14] have suggested a patch-oriented CNN method to use image patches derived from chest X-ray illustrations to develop the ResNet18 structures. They used the majority voting method for decision-making, which has an output of 88.9 percent. For automatic recognition of COVID-19 situations through X-ray illustrations, an objected recognition-dependent dark covid net structure has been suggested by Ozturk et al. [15]. For binary cataloging of X-ray illustrations obsessed by COVID-19, they registered efficiency of 98.08 percent.

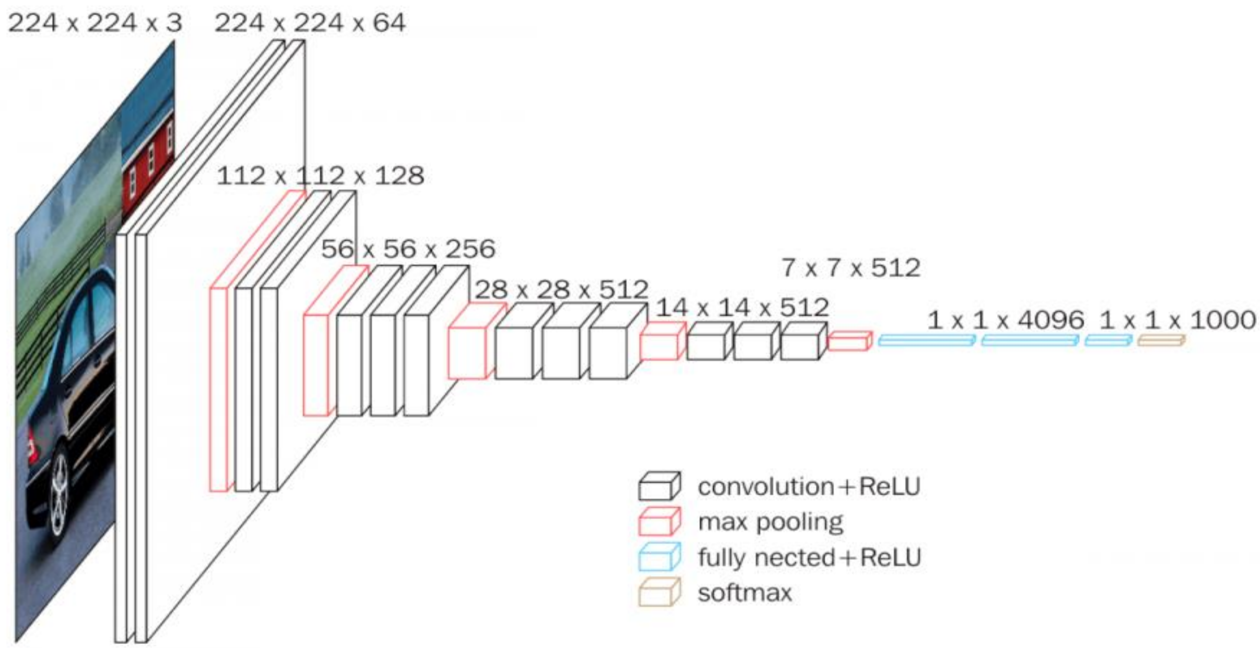

Fig. 2: VGG-16 architecture

This method also obtained an accurateness of 87.02 percent for different-class cataloging of X-ray illustrations into COVID-19, no discoveries and pneumonia. A hierarchical classification method was proposed by Pereira et al. [16], in which deep features were extracted by recognition V3 and texture classifications were checked. Contemporary and late fusion approaches were explored to combine descriptor and classifier power. The X-ray pictures of COVID-19 detection, their hierarchical classification method obtained an efficiency of 0.89. The automated broadcast of COVID-19 from the CT illustrations, the attention-based deep 3D multiple instances knowledge method was developed by Han et al. [17]. Their algorithm obtained an accuracy of 97.9%. A deep learning supervised model was produced by Wang et al. [18], in which the lung area was separated from the CT illustrations by UNet and the 3D deep neural systems were applied to the segmented region to find the likelihood of COVID-19 infections. The authors reported an output of 90.10%. A Squeeze Net CNN approach with Bayesian requirement aimed at the recognition of COVID-19 from X-ray illustrations was suggested by Ucar et al. [19]. They recorded 98.26 percent accuracy. A capsule structure system for segmentation of X-ray illustrations into Non-COVID, Bacterial, COVID-19 and Normal categories was developed by Afshar et al. [20]. The authors recorded 95.7 percent accuracy and 90 percent sensitivity. Sethy et al. [21] suggested deep X-ray image characteristics from the CNN pre-trained and applied the SVM to the extracted X-ray image classification function. Using ResNet50 with the SVM segmentation, the authors obtained an accuracy of 95.38%.

3. Proposed Method

Few experiments have been performed used of CT images for deep CNN identification of COVID-19. In every CNN models, various structures and convolution layers are built that help extract basis and advanced outputs from a given CT illustration input [9]. A CNN model suggested by K is VGG16. Simonyan [22] from Oxford University in their article 92.7 percent top-5 test output in Image Net is obtained by the model. As depicted in Fig.2, VGG-16 consists of 16 layers. Convolution layers in these 13, and 3 are entirely related. Multiple 3-3 kernel-sized filters are used.

4. Results and discussion

Firstly, we gather public chest CT photographs that are available. In the next step, we pre-processed the given dataset using the basic stabilization approach to enhance the accuracy of pictorial data of the input information. 449 COVID-19 CT pictures (positive) and 463 non-COVID-19 CT illustrations (negative) [14] are used in the COVID-19 CT information. Fig. 3 and Fig. 4 display the COVID and non-COVID image samples included in the dataset. It takes millions of data to CNN train model from graze and to produce the best performance, and given that our dataset includes only 802 images, it was elusive to a new CNN train model from scratch. Therefore, we have used transfer learning as an alternative to proposing pre-trained models [15]. The weights of a given model are first initialized for a task, using large-scale datasets rather than practicing from scratch, in transfer learning, and then the trained characteristics are added to the problem set. Such a method eliminates computational costs, statistical equations, and hardware constraints and helps concentrate on the decided task [16]. In the proposed VGG-16 model, the CT image was labeled as either positive COVID-19 or COVID-19 negative. In the ImageNet competition, the goal of choosing the individual models was their success. For the input of VGG-16 [17], all CT images are resized to 224* 224 pixels.

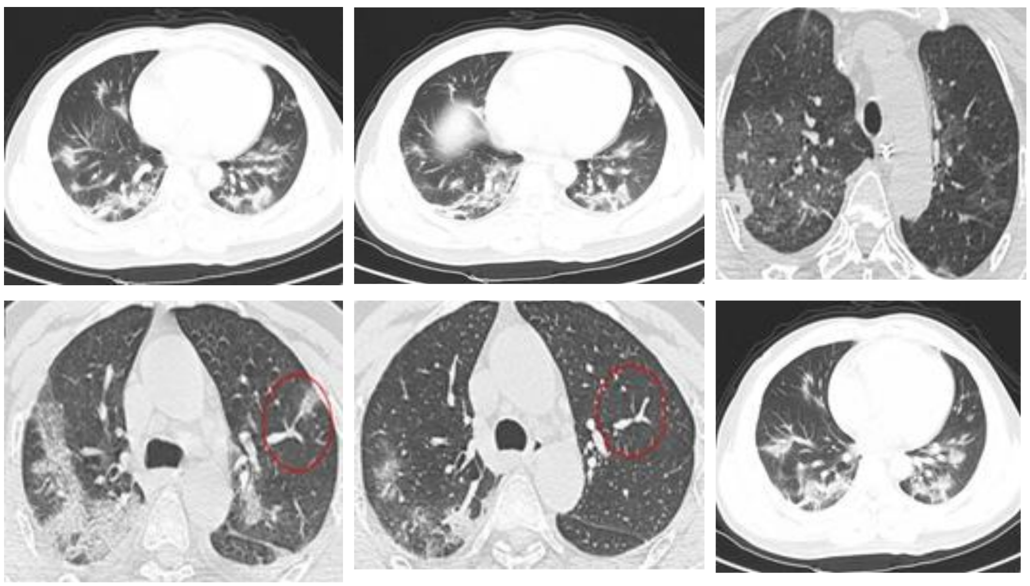

Fig. 3: Covid-19 data sample set images

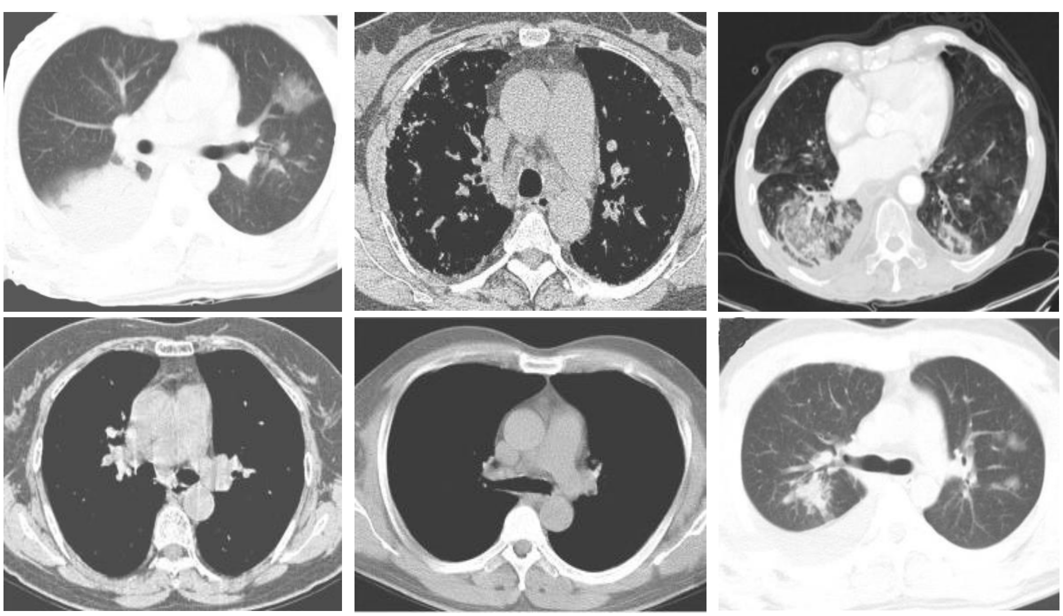

Fig. 4: Non-Covid sample data set images

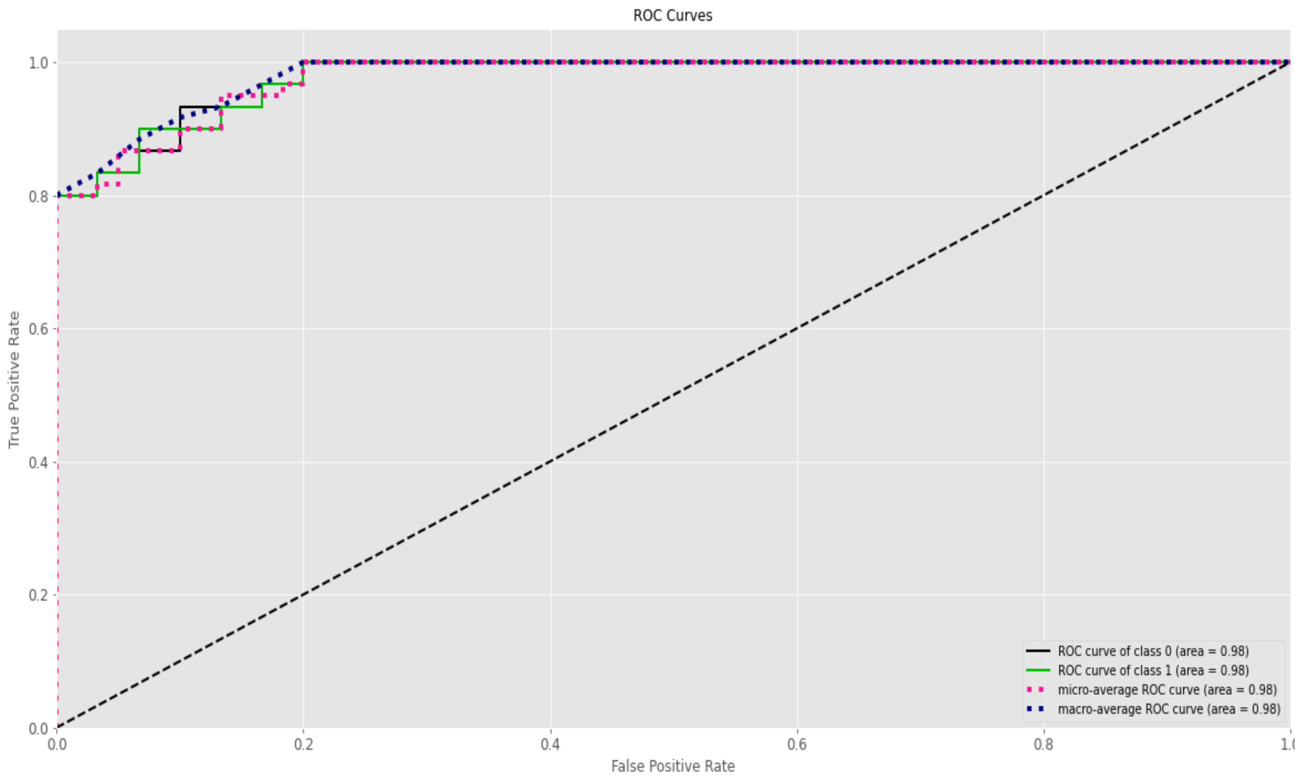

Fig. 6: ROC curve

The training protocol for VGG16 follows the definition of discriminative layer preparation. The transfer learning parameters of the following hyperparameters for the described models: batch size is 32, adam optimizer function, flattened loss, and learning rate modified between (1e-6, 1e-4). Using the Keras library, the given procedure was implemented. For the test data collection, Figure 5 indicates the uncertainty matrix. The proposed model archives of VGG-16 have an accuracy of 98.33%.

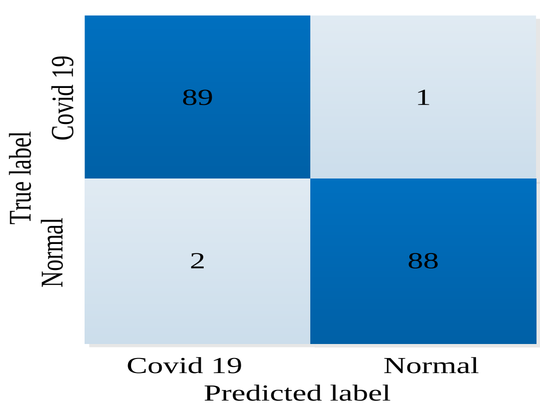

Fig. 5: Confusion matrix of VGG-16 model

5. Conclusion

A model based on VGG-16 to find COVID-19 from CT illustrations is provided in this article. These model findings based on VGG-16 support the radiologist in making an appropriate diagnosis decision relevant to a patient's current medical condition. The proposed researches revealed the possibility of a deep learning strategy to help doctors identify COVID-19 patients and inevitably find lacerations since CT illustrations. The proposed method would easily classify patients by getting high success on both pneumonia identification and segmentation tasks.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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