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COVID-19 identification in ct images based on deep learning models: A comparative approach

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***Abstract*---**People's lives could be in danger if a contagious disease spreads quickly, Corona-2019 virus disease (COVID-19) is one. The coronavirus epidemic rapidly spread over the world. The Corona virus has had a major impact on the health of populations and healthcare systems all over the world. RT-PCR (RT-Reverse transcription, PCR-polymerase chain reaction) testing can benefit from the use of computed tomography images. Most available methods use large training data, and the detection accuracy needs to be improved due to the inadequate border segment of symptom descriptions. This study proposes a robust and effective way for identifying normal and COVID-19 patients using small training data. Deep learning quickly creates accurate models. Data augmentation increases the training dataset to reduce over fitting and improve model generalisation. Using data augmentation, we evaluated Xception and VGG-19. The study showed that deep learning can detect COVID-19.

***Keywords*---**COVID-19, identification, epidemic rapidly.

Introduction

The COVID-19 infection, which at first resembled the common flu, has now been formally classified as a pandemic and has so far infected more than 556,000,000 globally including 6,000,000 deaths. In 2019, COVID-19, a virus, was discovered in the Chinese city of Wuhan. According to many research, the number of

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exposed, infected, or recovered humans could be used to forecast the expansion of infection curves. These research made it possible to acquire a sense of the mode of transmission that might exist in each nation [1] [2].

The test of COVID-19 relies on collecting swab from the nostrils. When the case is asymptomatic or exhibits only minor symptoms, it is typically performed at home by a healthcare expert. If the patient is admitted for a serious ailment, it is typically performed in a health facility or hospital. In nations like German or South Korea, doing as several examinations as possible has proven to be the most effective method of containing the virus. Spain was unable to do as many tests, so it is critical to investigate and create alternate techniques to carry out these tests quickly and efficiently.

The detection and monitoring of the disease can be aided by the use of AI and radiomics to computed tomography and X-ray images [3] [4]. According to [5], prominent ground grass opacity patches in the posterior and peripheral lungs are suggestive of COVID-19 pneumonia. As a result, once abnormalities on chest radiographs are suggestive of a coronavirus, CT can be a crucial way for detection of COVID-19. AI algorithms and CX-R radiomics characteristics help to diagnose COVID-19 [6] [7].

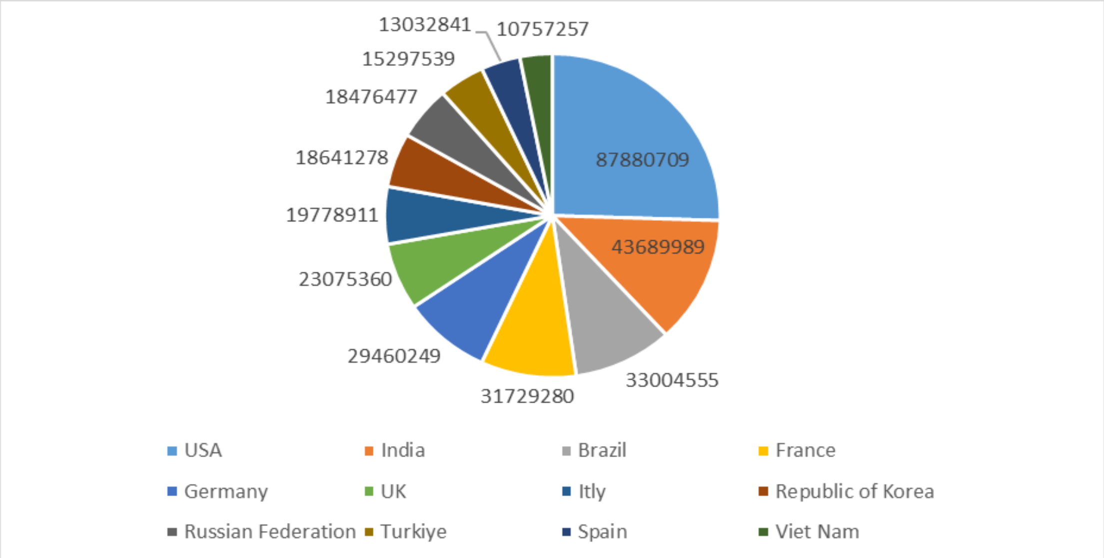

Figure 1 Globally Identified COVID-19 Cases (Source WHO[12])

Doctors and researchers struggled to quickly diagnose the condition [8]. An infection with the COVID-19 virus can result in major health complications such as a fast drop in blood pressure, a cardiac arrest, acute renal failure, and pulmonary edoema [9]. It is essential to make an early diagnosis of infection in patients and then immediately isolate them in order to make headway against and manage the COVID-19 pandemic [10,11]. Figure 1 presents the incidence rate of COVID-19 cases that have been reported in the countries that have been hit the worst all around the world [12]. Real-time PCR (polymerase chain reaction) is most frequent for corona detection. It has a significant false negative rate and takes up to two days to get results, but it's 70 to 90% sensitive [9-13]. COVID-19 is diagnosed by CXR and CT (CT). CXR is a quick, affordable, frequently used clinical treatment with less radiation than CT scans [13, 14,15]. On a CXR, radiologists must search for COVID-19 symptoms. CXR analysis is a time-consuming and error prone process that should be automated [16]. Figure 2 presents a Computed tomography image.

An image-processing model, such as the one used in this study, can identify areas of damage and accurate features that might be useful in determining the disease's severity. Using deep learning techniques, Fátima A. et al. [17] and Walaa G. et al. [18]. Developed a system that would create several lung sections and identify the infection. With the use of CT scans, this research proposes a deep learning (DL) strategy to forecast COVID-19 symptoms in patients. Deep learning techniques improve on conventional ML (machine learning) methods. Convolutional neural networks are utilised in image classification. In this work, we employed Xception and VGG16, two predesigned networks.

A variety of fields, like classifiers and pattern recognition, have demonstrated the superiority of CNNs, among the most effective deep learning (DL) models [19,20]. A number of other medical imaging systems that make use of DL approaches have also been developed as a means of assisting doctors and specialists with the accurate diagnosis, treatment, and follow-up assessment of COVID-19 [21,22]. COVID-19 infections have been detected in CT/CXR images using various DL approaches [23–36], with mixed results.

Vulnerabilities have been discovered during the research of COVID-19 detection and investigative systems based on CT/CXR imaging. The mainstream of recent methods has been evaluated with restricted CT/CXR datasets and few corona positive cases. The dimension of the datasets isn't big enough to show what the proposed systems will really do. Also, even though several researchers have used pre-trained models to get high reliability values over TL (transfer learning), there hasn't been much emphasis on system design and training a custom Deep learning model from scratch because there hasn't been a big dataset with a lot of CT/CXR images that have been reported to have COVID-19 infection.

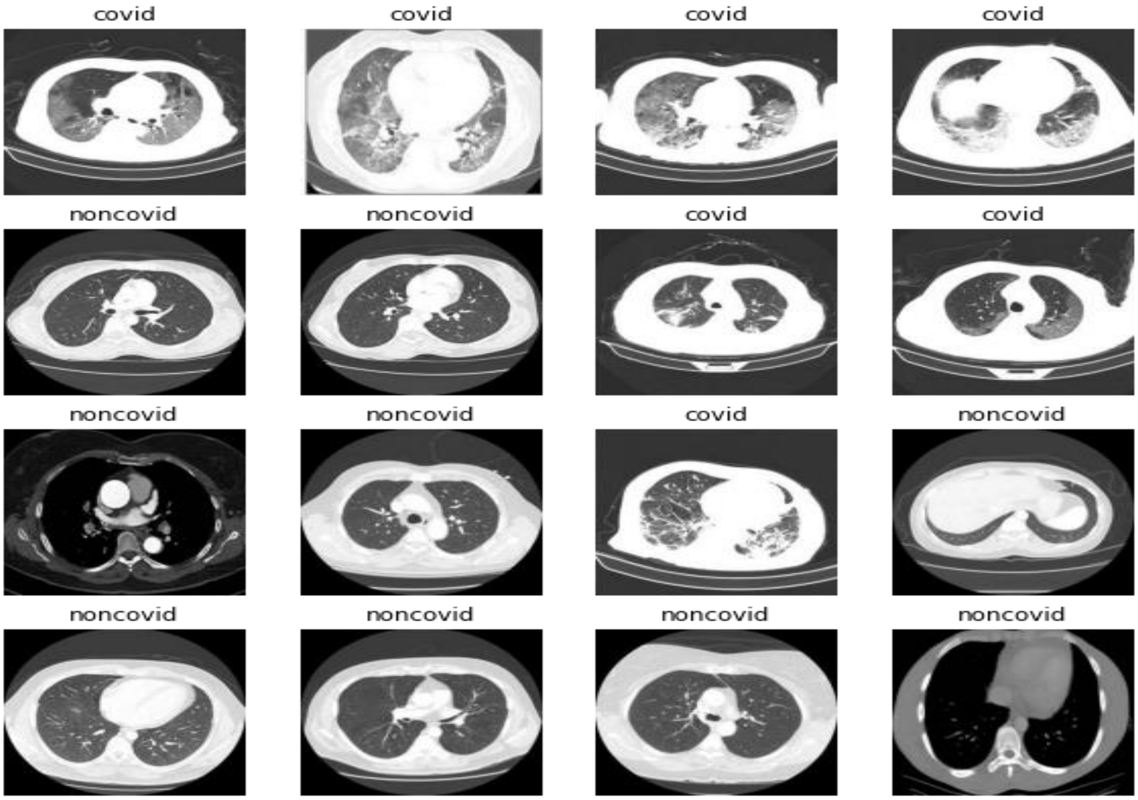

Figure 2 Sample CT scan Images from Database

I. Materials

The effectiveness of deep learning models on CT scans was tested in this work using [35,36] datasets. We suggest a dataset made up of COVID-19 and normal images. Both are accessible to the general public via GitHub and Kaggle, respectively. The COVID-19 cases are represented by the X-ray or CT scans that are accessible on GitHub. It was made by combining medical illustrations from publicly accessible websites and publications. 1874 regular CT pictures and 1571 COVID-19 images are included in this dataset.

In order to prevent biassed results, we split the images into training and testing sets at a ratio of 80, 20 percent respectively. This balanced division of the data ensures that there are sufficient numbers of samples from each class in the training set. Despite having a huge number of Covid-19 and normal images, we have assembled a dataset of 3445 photographs for this purpose. The datasets were obtained from a collection of open sources. Since datasets are updated often, future research may use different numbers of photos that were obtained. Table 1 demonstrates how various pretrained models require various input sizes. As a result, all photos were scaled in accordance with each pretrained model's training requirements. The decision to employ that particular architecture was made based on the successful usage of CNNs in cutting-edge efforts for COVID-19 image classification.

II. Methodology

This paper recommends CT scans to identify presence of corona virus in patients. The suggested approach contains Xception and VGG16. The results are compared to earlier results from the literature. Initial data pre-processing was done following open-source data collection. Several images were with different sizes, so they could not be taken for processing in the training, so entirely CT scan images were converted to the size requirement of the Xception and for VGG 16 model, varied data intensification techniques, including rotation, image flipping, and zooming, were used to ensure good output results.

Study Models

Table 1 Models taken for study

Model	**I/P size**	**No. of Layers in the model**	**Parameters (in Millions)**	**Model size in MB**
Xception	299x299x3	71	22.9	85
VGG16	224x224x3	16	138	528

The data were rescaled in a manner that was specific to each model. Each model was trained with Adam optimizer and 1e-4 learning rates to minimise overfitting in training stage. The batch size was maintained at 32 throughout the training process, while the epoch count was set at 100.

III. Experimental Results and comparison

Large enough trials were conducted on the data to illustrate the proposed DL system's efficiency and compare it with current state-of-the art methods. Code for the suggested system was written in Python and tested on Windows 10 using an i5-650U CPU (with 4 GB of Nvidia GPU enabled) and 16 GB of RAM. We used the performance measures of average Accuracy to compare our suggested system to existing systems.

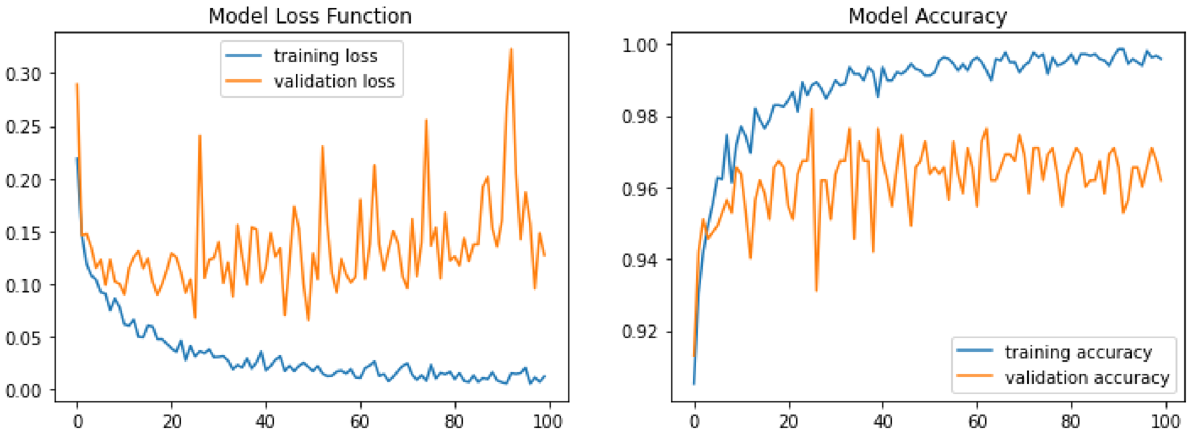

Figure 3 VGG16 Loss and Accuracy

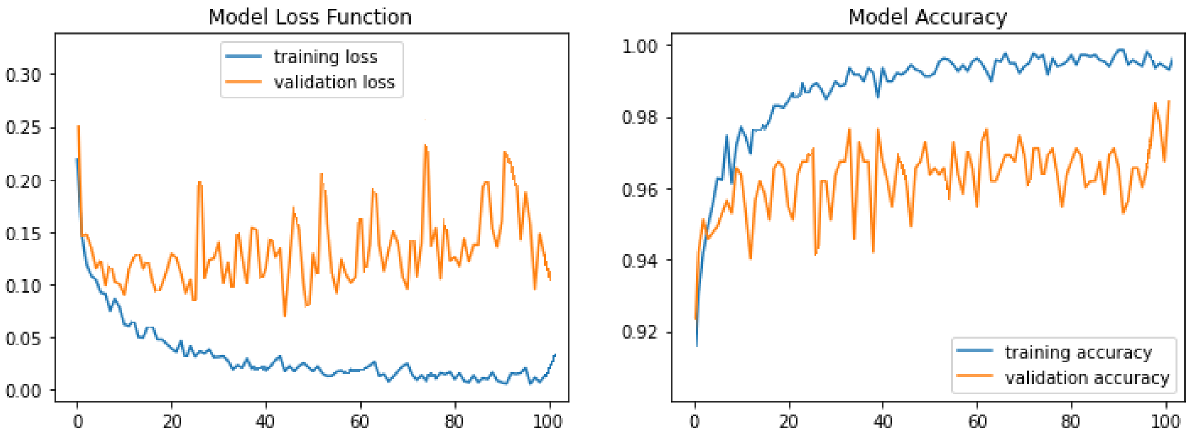

Figure 4 Xception Loss and Accuracy

According to the comparison presented in table 2, the average accuracy of the research undertaken by various authors is shown.

Table 2 Comparison of different studies

Author & [Ref.No]	**Class**	**Model used**	**Average Accuracy**
Sahinbas et al. [23]	Covid & Normal	VGG-16, VGG-19, ResNet, DenseNet, and InceptionV3	80%
Jamil et al. [26]	Covid & Normal	Deep CNN	93%
Joaquin. [27]	Covid & Normal	ResNet-50	96.2%
Wang et al. [28]	Covid & Normal	CNN	83.5%
Ezzat et al. [29]	Covid & Normal	DenseNet121+GSA	98.3%
Zhang et al. [30]	Covid & Normal	ResNet	95.18%(AUC)
Toraman et al. [31]	Covid & Normal	Capsule Network	97.24%
Rajaraman, et. al.	Covid & Normal	VGG16	93.0%

[32]			
Afshar, P. et al. [33]	Covid & Normal	capsule network	97.2%
Elshennawy, et. al. [34]	Covid & Normal	ResNet152V2, MobileNetV2	99.22%
Our Approach	Covid & Normal	VGG16	95%
	Covid & Normal	Xception	98%

Conclusion

There have been a great number of research conducted on the detection of COVID-19 symptoms using a variety of approaches. Using CT and chest X-ray scans, patients who exhibited symptoms of COVID-19 were evaluated for a diagnosis as part of this research project. Researchers from a wide variety of institutions have trained and evaluated a variety of deep learning models; nevertheless, there are still issues with the number of epochs, datasets, batch sizes, and optimizers. There is always the potential for a dispute to arise when trying to demonstrate that one model is more successful than another. This study demonstrates that the accuracy of a deep learning model was determined to be sufficient in order to correctly recognise and categorise COVID-19.

References

[1] Afshar, P.; Heidarian, S.; Naderkhani, F.; Oikonomou, A.; Plataniotis, K.N.; Mohammadi, A. Covid-caps: A capsule network-based framework for identification of covid-19 cases from X-ray images. Pattern Recognit. Lett. **2020**, 138, 638–643.

[2] Al-Waisy, A.; Mohammed, M.A.; Al-Fahdawi, S.; Maashi, M.; Garcia-Zapirain, B.; Abdulkareem, K.H.; Mostafa, S.; Kumar, N.M.; Le, D.N. Covid-deepnet: Hybrid multimodal deep learning system for improving covid-19 pneumonia detection in chest X-ray images. Comput. Mater. Contin. **2021**, 67, 2409–2429.

[3] Chatfield, K.; Simonyan, K.; Vedaldi, A.; Zisserman, A. Return of the devil in the details: Delving deep into convolutional nets.arXiv **2014**, arXiv:1405.3531.

[4] Chavez, S.; Long, B.; Koyfman, A.; Liang, S.Y. Coronavirus Disease (COVID-19): A primer for emergency physicians. Am. J. Emerg. Med. **2021**, 44, 220–229.

[5] Das, N.N.; Kumar, N.; Kaur, M.; Kumar, V.; Singh, D. Automated deep transfer learning-based approach for detection of COVID-19 infection in chest X-rays. Irbm 2020, in press.

[6] Elghamrawy, S.M.; Hassnien, A.E.; Snasel, V. Optimized Deep Learning-Inspired Model for the Diagnosis and Prediction of COVID-19. Comput. Mater. Contin. 2021, 67, 2353–2371.

[7] Elshennawy, N.M.; Ibrahim, D.M. Deep-pneumonia framework using deep learning models based on chest X-ray images. Diagnostics **2020**, 10, 649.

[8] Ezzat, D.; Hassanien, A.E.; Ella, H.A. An optimized deep learning architecture for the diagnosis of COVID-19 disease based on gravitational search optimization. Appl. Soft Comput. **2020**, 98, 106742.

[9] F. Song, N. Shi, F. Shan, Z. Zhang, J. Shen, H. Lu, Y. Ling, Y. Jiang and Y. Shi, "Emerging 2019 Novel Coronavirus (2019-nCoV) Pneumonia," Radiology, vol. 295, pp. 210-217, 2020.

[10] G. Chassagnon, M. Vakalopoulou, N. Paragios and M.-P. Revel, "Artificial intelligence applications for thoracic imaging," European Journal of Radiology, vol. 123, p. 108774, 2020.

[11] Gaál, G.; Maga, B.; Lukács, A. Attention u-net based adversarial architectures for chest X-ray lung segmentation. arXiv 2020, arXiv:2003.10304.

[12] Gouda, W., Almurafeh, M., Humayun, M., & Jhanjhi, N. Z. (2022). Detection of COVID-19 Based on Chest X-rays Using Deep Learning. *Healthcare (Switzerland)*, *10*(2). https://doi.org/10.3390/healthcare10020343

[13] J. C. L. Rodrigues, S. S. Hare, A. Edey, A. Devaraj, J. Jacob, A. Johnstone, R. McStay, A. Nair and G. Robinson, "An update on COVID-19 for the radiologist-A British society of Thoracic Imaging statement," Clinical Radiology, 2020.

[14] J. Wu, J. Liu, X. Zhao, C. Liu, W. Wang, D. Wang, W. Xu, C. Zhang, J. Yu, B. Jiang and others, "Clinical characteristics of imported cases of COVID-19 in Jiangsu province a multicenter descriptive study," Clinical Infectious Diseases, 2020.

[15] J. Zhang, Y. Xie, Y. Li, C. Shen, and Y. Xia, "COVID-19 screening on chest X-ray images using deep learning based anomaly detection," vol. 12338, 2020.

[16] Jamil, M.; Hussain, I. Automatic detection of COVID-19 infection from chest X-ray using deep learning. medRxiv **2020**.

[17] Joaquin, A. Using Deep Learning to Detect Pneumonia Caused by NCOV-19 from X-ray Images. 2020 Available online: https://towardsdatascience.com/using-deep-learning-to-detect-ncov-19-from-x-ray-images-1a89701d1acd (accessed on 13 June 2022).

[18] K. Roosa, Y. Lee, R. Luo et al., "Real-time forecasts of the COVID-19 epidemic in China from february 5th to February 24th, 2020," *Infectious Disease Modelling*, vol. 5, pp. 256–263, 2020.

[19] Khalil, M.I.; Tehsin, S.; Humayun, M.; Jhanjhi, N.; Zain, M.A. Multi-Scale Network for Thoracic Organs Segmentation. Comput. Mater. Contin. **2022**, 70, 3251–3265.

[20] L. Yan, H.-T. Zhang, J. Goncalves et al., "A machine learningbased model for survival prediction in patients with severe COVID-19 infection," *medRxiv*, pp. 1–18, 2020.

[21] Litjens, G.; Kooi, T.; Bejnordi, B.E.; Setio, A.A.A.; Ciompi, F.; Ghafoorian, M.; Van Der Laak, J.A.; Van Ginneken, B.; Sánchez, C.I. A survey on deep learning in medical image analysis. Med. Image Anal. **2017**, 42, 60–88.

[22] M. Sandler, A. Howard, M. Zhu, A. Zhmoginov, and L.-C. Chen, "Mobilenetv2: inverted residuals and linear bottlenecks," 2018, https://arxiv.org/abs/1801.04381.

[23] Mair, M. D., Hussain, M., Siddiqui, S., Das, S., Baker, A., Conboy, P., Valsamakis, T., Uddin, J., & Rea, P. (2021). A systematic review and meta-analysis comparing the diagnostic accuracy of initial RT-PCR and CT scan in suspected COVID-19 patients. *The British journal of radiology*, *94*(1119), 20201039. https://doi.org/10.1259/bjr.20201039

[24] Mostafavi, Sayyed Mostafa, 2021, "COVID19-CT-Dataset: An Open-Access Chest CT Image Repository of 1000+ Patients with Confirmed COVID-19 Diagnosis", https://doi.org/10.7910/DVN/6ACUZJ, Harvard Dataverse, V1

[25] Narin, A.; Kaya, C.; Pamuk, Z. Automatic detection of coronavirus disease (Covid-19) using X-ray images and deep convolutional neural networks. Pattern Anal. Appl. 2021, 24, 1207–1220.

[26] Qingyu Chen, Alexis Allot, Zhiyong Lu, LitCovid: an open database of COVID-19 literature, *Nucleic Acids Research*, Volume 49, Issue D1, 8 January 2021, Pages D1534–D1540, https://doi.org/10.1093/nar/gkaa952

[27] Rajaraman, S.; Antani, S. Training deep learning algorithms with weakly labeled pneumonia chest X-ray data for COVID-19 detection. medRxiv **2020**. 10.1101/2020.05.04.20090803.

[28] S. Chauvie, A. De Maggi, I. Baralis, F. Dalmasso, P. Berchialla, R. Priotto, P. Violino, F. Mazza, G. Melloni and M. Grosso, “Artificial intelligence and radiomics enhance the positive predictive value of digital chest tomosynthesis for lung cancer detection within SOS clinical trial,” European Radiology, p. 1–7, 2020.

[29] S. Wang, B. Kang, J. Ma et al., “A deep learning algorithm using CT images to screen for corona virus disease (COVID- 19),” *medRxiv*, pp. 1–26, 2020.

[30] Sahinbas, K.; Catak, F.O. Transfer learning-based convolutional neural network for COVID-19 detection with X-ray images. In Data Science for COVID-19; Elsevier: Amsterdam, The Netherlands, 2021; pp. 451–466.

[31] Saiz, F., & Barandiaran, I. (2020). COVID-19 Detection in Chest X-ray Images using a Deep Learning Approach. *International Journal of Interactive Multimedia and Artificial Intelligence*, *6*(2). https://doi.org/10.9781/ijimai.2020.04.003

[32] Shen, D.; Wu, G.; Suk, H.I. Deep learning in medical image analysis. Annu. Rev. Biomed. Eng. **2017**, 19, 221–248.

[33] Simonyan, K.; Zisserman, A. Very deep convolutional networks for large-scale image recognition. arXiv **2014**, arXiv:1409.1556.

[34] Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2021). Get vaccinated when it is your turn and follow the local guidelines. *International Journal of Health Sciences*, *5*(3), x-xv. https://doi.org/10.53730/ijhs.v5n3.2938

[35] Toraman, S.; Alakus, T.B.; Turkoglu, I. Convolutional capsnet: A novel artificial neural network approach to detect COVID-19 disease from X-ray images using capsule networks. Chaos Solitons Fractals **2020**, 140, 110122.

[36] WHO Coronavirus (COVID-19) Dashboard. Available online: https://www.who.int/emergencies/diseases/novel-coronavirus-2019

[37] X. Zhang, X. Zhou, M. Lin, and J. S. Shufflenet, “An extremely efficient convolutional neural network for mobile devices,” 2017, https://arxiv.org/abs/1707.01083.