Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2024, 11(4):70-76**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Classification Covid-19 Chest X-Ray based on Deep Neural Network

Hanan B. Ahmed[1], Adham H. Saleh[2], Huda I. Hamd [3]

[1,2,3] University of Diyala, Collage of Engineering, Department of Electronic Engineering
Email: [1]hananbadeea79@uodiyala.edu.iq, [2]adham.hadi@yahoo.com ,[3] huda.ibrahim@uodiyala.edu.iq

Abstract The well-transformed algorithms used in gadget education at build acknowledging tasks are now compatible with a period of greatly growing use of diagnostic imaging and electronic medical gadgets. The astounding dexterity of picture recognition jobs executed using appliance education algorithms coincides with a period of markedly enhanced utilization of electronic health data and diagnostic imaging. These algorithms focus on convolutional neural networks and highlight the medical features of the area, making them a helpful tool for analyzing medical images. The result structure validates the areas of key research and applications of medical image classification, segmentation & registration and detection localization. The work is an attempt to understand and identify a coronavirus based on the 3000 chest x-ray images of 3000 patients using Deep Network Designer in MATLAB 2021a with conventional neural network based on DNN Technique. The accuracy is 99.7% and the classification results are satisfied and hopping to take more classes for classification in future.

Keywords COVID-19; Classification; CNN; electronic medical devices

1. Introduction

Throughout 2019, Wuhan (Hubei, China) experienced an increase in occurrences of inconclusive emissaries. Inherent and accurate study of lower respiratory tract tests detected a novel virus, plain critical respiratory syndrome coronavirus 2 (SARS-CoV-2), as a contributing agent for the reported pneumonia cluster in January 2020, following a period of time. SARS-CoV-2 causing the disease and was designated as "COVID-19" by WHO, from the declaration of it by WHO on February 11, 2020. The WHO then declared the pandemic status on March 11, 2020, when the disease had extended to more than 114 countries, with very large number of cases deaths. The key tool in detection process is the chest, X-rays (radiography) or image which gives a clear envision of the chest status in the two-dimension image of it. In hospitals, there is a counter in the close of Computed tomography (CT) images to join two-dimension image apparatus by a radiographer, they can also be attained on portable machines; X-ray images and convert them into a three-dimension image. The confirmed level was made, hanged and over in recovery centers by a biblical radiographer, and they use Ultrasound scans of high-frequency sound waves to generate an image. [3] Conflicting chest scans, conveyable X-Ray apparatus over furnish study preferred an isolation enclose itself, it over removes the danger of hospital grew disease for the patient. [4] However, a multi-layer neural network usually at minimum 2 layers, be appropriate as an unsolvable depth neural network (DNN). DNN conclude facts and relationship between input and output by using high-level math modeling. Different specialists describe the feature of DNN range in addition an input, a gain coagula and at least a few hidden layers inside between them. Each layer supervises broad classes of ordering and sort in a mode called “feature hierarchy”. The most important usage among these involved neural networks is dealing with unlabeled or unformed data. The limitation “deep style” is fascinated to define DNN,

as deep neural network which mean learning techniques using the ability search for classify and train data in approaches that simplify the input-output terminals [10].

Neural Network represents an inventive model, while a Deep Neural Network is much more complicated than Neural Network. It ‘s application is very vital like graphics, evaluation & estimation, stamp sound, trade mark acceptance prescription, creative thinking, and intelligent analytics in a manner as the human brain analyze. Neural Network is at variance with (an advertisement, a solution, a numeral, or an action), while the Deep Neural Network resolve the issue more commonly and able to set inferences or predications depending on the information conveyed and the desired output. Neural Network needs an assenting input of information and answers in a form of an algorithms, and the Deep Neural Network can investigate a problem without a main amount of categorized data. [11]. Recently, some techniques augmented Corona virus disease test X-rays by employing NN. Ali Narin et al, suggested a 5 pre-trained Convolutional Neural Network which adopt the nets (Inception-ResNetV2, ResNet50, ResNet152, ResNet101, and InceptionV3) to connect Covid 19 pneumonia affected patient by chest X-ray test. They have achieved three different binary classifications each one includes four classes with fivefold cross authorization. Their results showed that the pre-trained ResNet50 system investigated the best classification interpretation from the other four suggested nets. [6]. A modern software was suggested by Pedro Moisés de Sousa et al. to classify X-ray tests of Covid-19 analysis. The benefits of chest X-ray scan over computed tomography scans are their fast results attainment, low cost, and easy entrance to X-ray sources. 10 training and testing terms were involved in the 2 data sets to evaluate accuracy network [7]. Linda Wang et al. created COVID-Net, which is a Deep Convolutional Neural Network model to detect Covid-19 cases using chest X-ray images. Generally, COVID-Net was one of the important resource systems to classify the Covid-19 using CTX images. Because of the increasing number of Corona virus positive patients being easily obtainable for authors to. So as to accelerate the improvement procedure, an available resource COVID x dataset was described plus extended upon employing scientific and citizen data [8].

In this paper, we modified Deep Network Designer, a deep CNN construction for COVID-19 image classification in a large dataset of CXR pictures, based on a class decay strategy. In addition to its capability to match information anomalies and a restricted quantity of training photos, DND offered strong and effective solutions for the categorization of corona virus cases. The maximum accuracy was obtained when the pre-trained CNN was checked with DND.

2. Classification

Computer-Aided Diagnosis (CADx) is one that you may come across from time to time. This task of detecting the CTX ray lattice is limited to medical applications; however, it serves as an example of the usefulness of information augmentation and pre-training in acquiring the important image of data as part of a fully programmed analytical design. Furthermore, on an experience of three thousand images, Convolutional Neural Networks depended on three thousand categorized CTX scans from (RIMS), the Italian Society of Medical and Interventional Radiology [15,16] to classify the chest for the corona pandemic. Nine analogous Convolutional Neural Networks with 2 convolution layers each were used in current paper, and each Convolutional Neural Network tested image patches at different levels to extract features. The result feature vector was initiated employing the modern learnt features, and it was classified latterly.

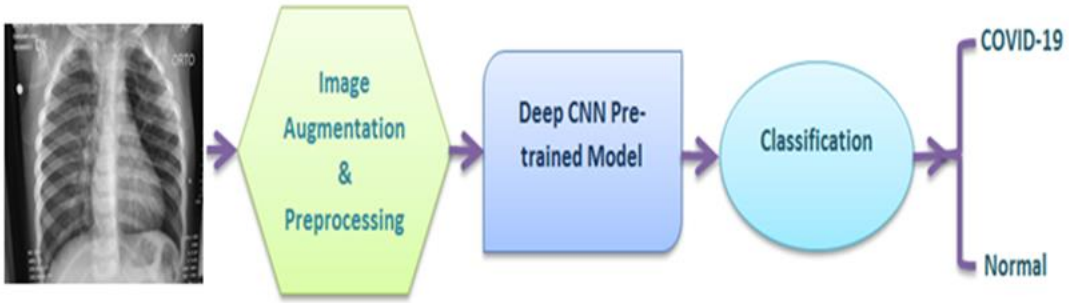

Figure 1: Block Diagram of proposed work

3. COVID-19 Chest X- Ray Images Dataset

The unique coronavirus presents a group of distinctive features. COVID-19's infection can be categorized by assuming the polymerase chain reaction. Some pattern on chest CT images of the Corona virus affected cases is difficulty obvious by human eye. Coronavirus patients show irregularities in chest scans with most having mutual association. Two-sided multiple lobular and sub segmental regions of alliance institute the standard discoveries in chest x-ray scans of intensive care unit (ICU) cases on admission. On the other side, non-emergency patients appear two-sided ground-glass opacity and sub segmental regions of alliance in chest x-ray scans of them. For these cases, recently chest x-ray scans present two-sided ground-glass opacity with determined alliance [27]. For this reason, to classify the coronavirus, the chest CT images are employed. In the proposed framework, dataset which used represents samples of normal and Corona virus x-ray images in size about 299 × 299 pixels taken from the Italian Society of Medical [16]. Many diverse data augmentation methods were applied to produce more models like overthrowing up-down and right/left, translation and spinning by means of arbitrary different angles. This technique gave a total of 3000 images. Also, the method of a histogram modification was involved to improve the differ for images indivisibly.

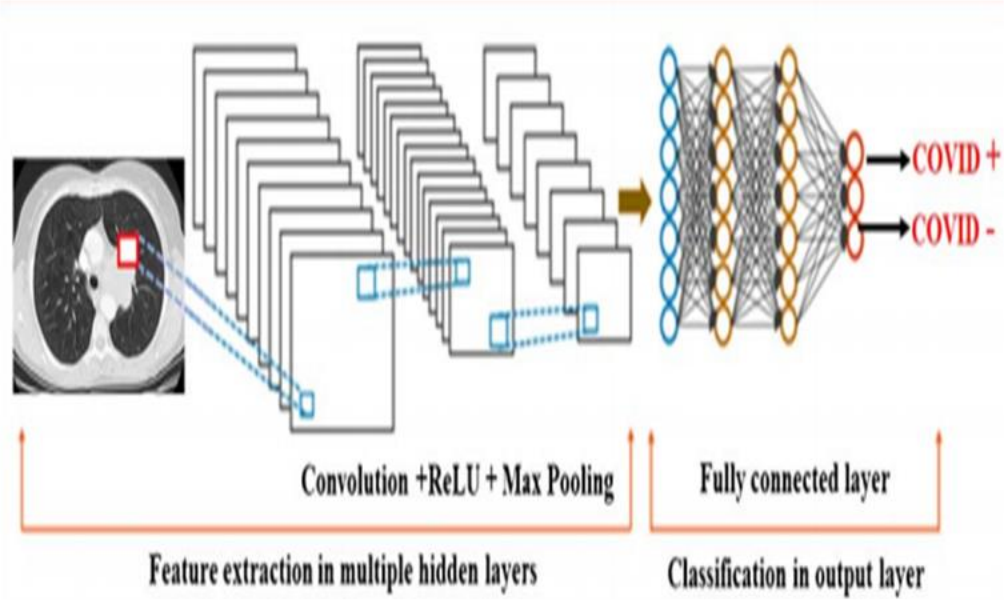

Figure 2: CNN Layers which initiated by DND (MATLAB 2021a) [11]

The Augment of Information

CTX datasets of corona virus are obtained from public contributions; however, they are lacking for complicated convolutional neural network training to have high accuracy. This paper assumes an augmentation system with no lack to rise in addition to preserve the dataset. To improve the functioning of deep learning model we require extra information, so augmentation method is employed to increase the information and execution accuracy [12]. 10 times the information group is up surged by expansion by means of the consequent algorithm. Elements of augmentation are, height shift range of 0.2, width shift range of 0.2, rotation range of 15 degrees, shear range of 0.2, zoom range of 0.2, brightness range of 0.2 and satisfy mode as closest. The pictures in the information group have various dimensions and for this reason all the pictures are changed into a dimension about 224× 224 × 3 pixels. The subsequent algorithm is pertained for image dataset augmentation. Figure (3) displays the different forms of COVID-19 X-Ray images taken into research.

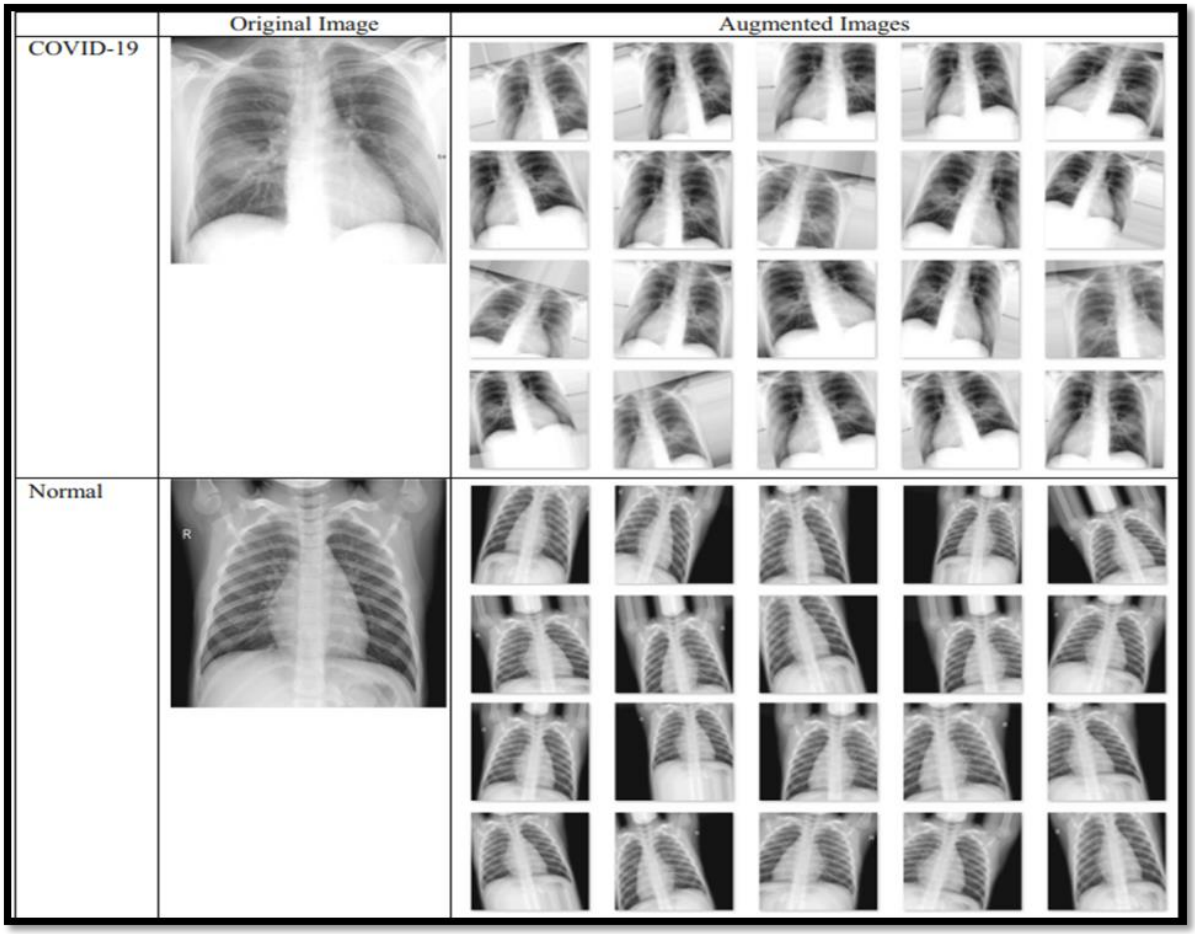

Figure .Chest X-ray augmented images of COVID-19 and normal. [15]

Using Deep Features for Class Decomposition

Deep network designer was employed in this work dependent on simple learning method to mine distinctive merits for the 3 basic classes. Network is comprised of 2 convolutional layers to signify learned features, 2 fully connected layers to perform the classification job. It involves 3 × 3 max-pooling layers, ReLU activation functions and 3 distinctive kernel filters. The proposed net assumed the fully connected layer into 2 classes in the end and initialized the weight elements for specialized classification task. Finally, it allocated the updated symbols to the updated sets, while each group is regarded as an distinct class. Accurately, we formed an updated dataset with 10 classes. Figure (4) shows the block diagram of proposed classification layers.

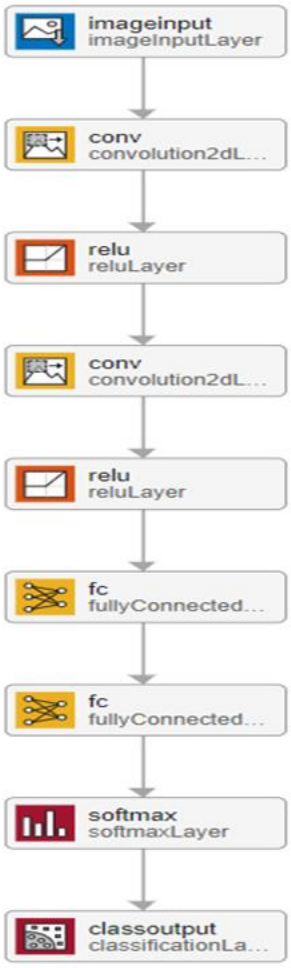

Figure 4: CNN Layers which initiated by DND (MATLAB 2021a)

Simulation Results

MATLAB 2021a has been used to implement the simulation results presented in this paper. Two sets of information were initiated: seventeen percent were utilized to train the system, and thirteen percent were utilized to evaluate the classification performance. In the suggested approach, we used Relue as an Image Net pre-trained network. With nine layers and an input image size of 299 x 299, the network achieved an accuracy of 97.99% in real-world performance. In order to categorize six classes, we modified the final fully-connected layer in the additional task. With the exclusion of the final fully connected layer, which had a learning rate of 0.01, all convolutional neural network layers had fixed learning rates of 0.0001. This permitted for quick learning. To avoid over fitting during the system's training, the momentum value was 0.95, the weight decay was 0.0001, and the minimum batch size was 128 with a minimum of 5 epochs. Every five epochs, the drop learning rate was set to 0.95. We took certain standards—accuracy, sensitivity, specificity, and precision—from the confusion matrix for the active execution evaluation. The curve of learning accuracy and loss between training and test, as indicated in figures (5) and (6), respectively, were registered and condensed in table 1.

Table 1: Result of Classification Process.

Standard	Value
Validation Accuracy	97.99%
Training Time	1 min 12 sec
Epochs Maximum Iterations	5 250

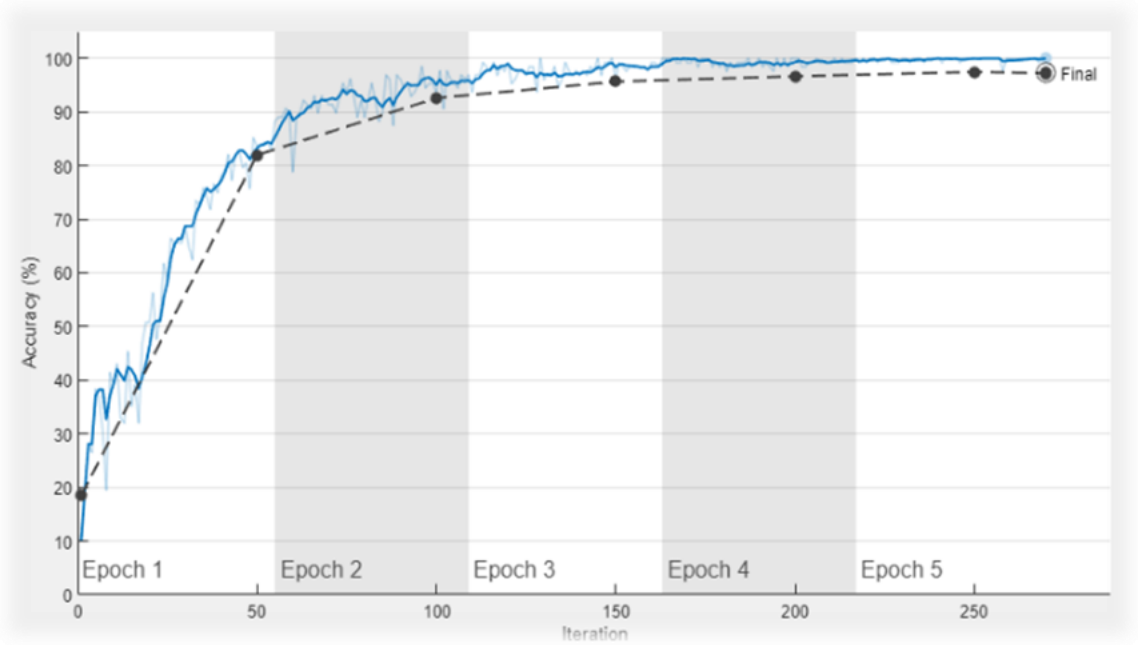

Figure 5: Training Accuracy Curve

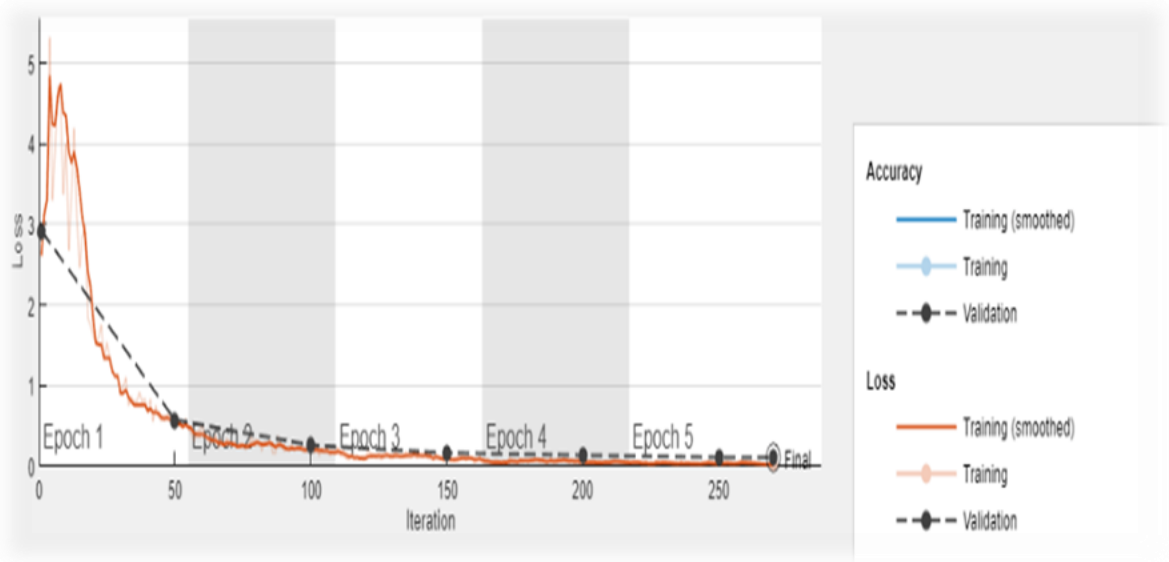

Figure 6. Testing Accuracy Curve

Conclusion

Symptoms of pneumonia are correlated with the detection of Corona virus and can be shown by imaging and genetic testing. With the help of an image test, COVID-19 may be quickly identified and the disease's spread can be controlled. The two imaging modalities that have the biggest impact on COVID-19 disease diagnosis are CT and CXR. Because large-scale glossed image datasets are available, tremendous advance has been done in deep Convolutional Neural Networks for medical scan categorization. Convolutional Neural Networks offer the direct learning of highly illustrative and hierarchical local picture characteristics from data. Nevertheless, addressing real COVID-19 instances from CXR pictures remains extremely challenging due to inaccuracies in interpreted data. In order to conduct this study, we made modifications to Deep Network Designer, a deep CNN architecture that employs a class decay strategy to identify Corona virus images inside a large dataset of chest x-ray images. Besides to its capability to match data anomalies and a limited quantity of training photos, DND

offered strong and effective solutions for the categorization of corona virus cases. The maximum accuracy was obtained when the pre-trained CNN was checked with DND. In the future, we hope to expand the validation process with larger datasets thanks to the ongoing data assembling. Similarly, our goal is to increase system usage by including an explain-ability part. Finally, quantization and system clipping will be utilized to increase efficiency and allow use on portable apparstuses.

References

[1]. Di Gennaro, F., Pizzol D., Marotta C., Antunes M., Racalbuto V., Veronese N. and Smith L.."Coronavirus Diseases (COVID-19) Current Status and Future Perspectives: A Narrative Review". 2021

[2]. Eric A, Aaron Richterman, Isaac I Bogoch, Nicola Low, and Muge Cevik, "Towards an accurate and systematic characterisation of persistently asymptomatic infection with SARS-CoV-2", Elsiver Public Health Emergency Collection, Jun 2021.

[3]. Islam N, et al, "How Accurate is Chest Imaging for Diagnosing COVID-19". 16 March 2021.R. T. Wang, “Title of Chapter,” in Classic Physiques, edited by R. B. Hamil (Publisher Name, Publisher City, 1999), pp. 212–213.

[4]. Chinmoy B., Anirvan B., " Classification of COVID-19 from CXR images in a 15 Class Scenario: An Attempt to Avoid Biase in the System", 25 Sep. 2021.

[5]. Kikkisetti, S., Zhu, J., Shen, B., Li, H. and Duong, T., " Deep-learning convolutional neural networks with transfer learning accurately classify COVID-19 lung infection on portable chest radiographs". PeerJ, 8, p.e10309.2020.D. L. Davids, “Recovery effects in binary aluminum alloys,” Ph.D. thesis, Harvard University, 1998.

[6]. Narin, A., Kaya, C. and Pamuk, Z., "Automatic detection of coronavirus disease (COVID-19) using X-ray images and deep convolutional neural networks". Pattern Analysis and Applications journal, 2021.

[7]. Pedro Moisés de Sousa'o, et al, " COVID-19 classification in X-ray chest images using a new convolutional neural network: CNN-COVID", Sociedade Brasileira de Engenharia Biomedica, 2021.

[8]. Wang, L., Lin, Z. and Wong, A., " COVID-Net: a tailored deep convolutional neural network design for detection of COVID-19 cases from chest X-ray images". 2020.

[9]. Gurney, K., " Neural networks for perceptual processing: from simulation tools to theories", Philosophical Transactions of the Royal Society B: Biological Sciences, 362(1479), pp.339-353.2007.

[10]. https://www.techopedia.com/definition/32902/deep-neural-network. [Accessed 29 July 2021].

[11]. https://www.kdnuggets.com/2020/02/deep-neural-networks.html [Accessed 29 July 2021].

[12]. Justin Ker, Lipo Wang, Jai Rao, and Tchoyoson Lim, "Deep Learning Applications in Medical Image Analysis", IEEE Access · December 2017 DOI: 10.1109/ACCESS.2017.2788044.

[13]. Singh, D., Kumar, V., Vaishali and Kaur, M., "Classification of COVID-19 patients from chest CT images using multi-objective differential evolution–based convolutional neural networks". 2021.

[14]. Abbas, A., Abdel samea, M. and Gaber, M., "Classification of COVID-19 in chest X-ray images using DeTraC deep convolutional neural network" Applied Intelligence, 51(2), pp.854-864.2020.

[15]. G. Appasamia and S. Nickolasb, “ A deep learning-based COVID-19 classification from chest X-ray image: case study”, THE EUROPEAN PHYSICAL JOURNAL, SPECIAL TOPICS , Published online 18 August 2022.