A novel method development for classification of COVID-19 Pneumonia in lungs Using Machine learning approach

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Abstract:

Artificial intelligence may be used to identify COVID-19 pneumonia (also known as pneumococcal meningitis) (AI). AI algorithms are also under scrutiny for their resilience and vulnerability, as are the datasets and research methods used to get the data. AI-driven COVID-19 pneumonia detectors that use our own data from retrospective clinical studies might help overcome these difficulties. In order to assess statistically the research designs, we optimized five deep learning architectures, applied development techniques by altering data distribution and introduced several detection scenarios to test the durability and diagnostic performance of the models. To a greater extent than the present data volume, detection model performance is influenced by hyper parameter adjustment. Sn, sp, and PPV are the three most important metrics in a two-class detection situation, and a method called InceptionV3 has the best of all three. It was shown that models had improved overall performance, with 91-96 percent Sn and 94-98 percent Sp and 91-96 PPV, compared to three-class detection results. Accuracy, F1 scores and g means are all higher than 96% accurate in InceptionV3, according to InceptionV3. For the identification of COVID-19 pneumonia, InceptionV3 had the greatest results, with an AUC of 99. An AUC of 0.98 distinguishes CoVID-19 pneumonia from other kinds of pneumonia, and a micro-average of 0.99 was achieved for the remaining classes.

***Keywords*:** AI-driven, COVID-19, InceptionV3, pneumococcal meningitis, PPV

DOI Number: 10.14704/nq.2022.20.9.NQ44513 Neuro Quantology 2022; 20(9):4484-4490

I. INTRODUCTION

In order to complement the present worldwide initiatives to avoiding its spread and any ensuing outbreak, a COVID-19 RT-PCR test is required. However, despite the fact that RT-PCR testing is the gold standard for diagnosing COVID-19, it is not widely accessible or scalable due to the high cost of the kit and the practical limits it imposes. As a result of this weakness, early suspicion testing employing radiologic technology has become prevalent. Studies have revealed that RT-PCR-based diagnosis may be less sensitive and specific than CXR analysis in the early stages of the disease. Furthermore, the COVID-19 misdiagnosis rate is rather high [4]. CXR technology is widely available, however many radiologists have difficulties interpreting CXRs due to the advent of radiological characteristics such as consolidation and hazy increasing opacities. AI-based detection method for COVID-19 pneumonia screening using CXR pictures is being developed in this way, driven by the latest technological advances.

Artificial Intelligence-based medical diagnostics have advanced significantly over the last several years for radiologists and physician. Improve the present diagnosis process in hospitals and ambulatory testing centers by using AI to identify complex patterns in x-ray pictures and provide quantitative evaluation. This approach is effective and scalable. Artificial intelligence (AI)-driven technologies were used early in the project to help radiographic examinations find COVID-19. Uses the COVID-Net, a convolutional neural network, to recognize COVID-19 cases from CXR images. For non-COVID-19 pneumonia, 13,800 CXR images yielded 92.6 percent accuracy and sensitivity (normal), 90.0 percent

(non-COVID-19 pneumonia), and 87.11% (COVID-19). Data from the US National Institutes of Health (NIH) was used to train AlexNet, VGGNet, and ResNet to tell apart between abnormal and healthy CXR images. 90% of the images in the training set were correctly classified as normal, other illnesses, pneumonia, and COVID-19 by models trained using transfer learning. The unconventional use of pre-trained architectures as feature extractors for transfer learning Turkglu [10] used AlexNet, Relief, and SVM to extract features and classify pictures using AlexNet, Relief, and SVM whereas Montalbo [11] used two short Densenets. In a separate research, AlexNet, GoogleNet, and ResNet were taught to make this prediction, and the majority of the participants agreed. Data augmentation procedures like as rotation, translation, flipping, and scaling may be used to increase the number of training

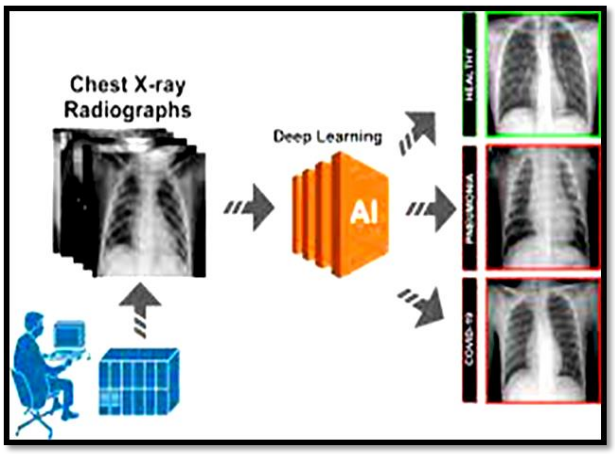

Fig – Detection of viruses

Some researchers are skeptical about the therapeutic use of AI models, despite the fact that classification trials have shown them to be very effective. The most apparent issues are data quality and quantity.. It is common for the datasets used to train AI models to come from publically available sources. In order to check the quality of these datasets, researchers need to look at the data themselves rather than at the information they were derived from. These medical images are hindered by the absence of demographic information and other possibly dangerous elements that prevent other ways from being used. The recentness of the pandemic has resulted in a smaller number of positive events, resulting in models being trained on an imbalanced dataset. In addition, researchers are unable to perform an appropriate retrospective study to analyse the findings' dependency on demographic features (such as age groups and gender) and other variables because of the absence of information on how these datasets were obtained..

II .LITERATURE REVIEW

In 2021, Candidates such as Shubham Chaudhary, Sadbhawna, Vinit Jakhetiya, Badri N. Subudhi, Ujjwal Baid, and Sharath Chandra Guntuku will all have their names on the ballot. In order to distinguish between COVID-19 and CAP, this study presented a two-step procedure. To begin, a DenseNet-based deep-learning architecture is being used to categorize CT images. In the second step, CoViD-19, CAP, and healthy people are grouped into two categories using fine-tuned Efficient Net topologies. In the binary classification challenge, the suggested two-stage framework obtained over 94% accuracy, while the fine-grained classification of COVID-19, CAP, and normal reached an accuracy of 89%. https://github.com/shubhamchaudhary2015/ct Model weights and source code are included in this package.

Feng Shi, Liming Xia, Dijia Wu, and Ying Wei are all represented in this group. . Using machine learning, CT imaging may be a viable technique for COVID-19 screening. Developing and assessing the procedures must account for this bias.

Hanan Farhat and George Sakr and Rima Kilany says that the existing dearth of health care facilities, PACs, and medical personnel in the Third World makes it more difficult to train models, which may lead to over-fitting, particularly when dealing with a broad range of imaging modalities and disorders. Even if training data is becoming more crucial, unsupervised learning may be a solution. As an example, self-supervised learning for segmentation and classification in 2D and 3D versions may be developed to encompass other picture modalities and populations. Even in underdeveloped nations, there aren't enough public datasets to meet the demands of deep learning models.

Rodrigo Olivares, Roberto Munoz, Ricardo Soto, Broderick Crawford, and Diego Cárdenas says that Parkinson's Disease, the most prevalent

cause of tremors and slowed movement, is a progressive disease of the brain. Early detection of cancer may be challenging. The first symptom of Parkinson's disease in a patient is a change in voice. Mechanics may be able to aid with vehicle diagnostics. In this research, an improved ELM is shown for accurately identifying Parkinson's disease patients. Approximation is used to construct an optimum vector that includes both weights and bias. ELM training is essential in developing an appropriate classification model. Using Parkinson's disease patient speech signals, we first suggest using the bat approach to calculate ELM parameters. If this succeeds, we'll report our findings.

Mohammad Rahimzadeh and Abolfazl Attar Researchers demonstrated the use of a concatenated neural network for the classification of normal, pneumonia, and COVID-19 X-ray images. A total of 8851 photos of healthy persons and 180 and 6054 photographs of COVID-19 and pneumonia patients, respectively, were obtained from two open-source datasets. Our neural network training method was inspired by the fact that we only had a few photos from COVID-19. The training set includes 633 photos (149 of COVID-19, 234 of pneumonia, and 250 of normal), one for each phase of the process. Thus, our network may learn COVID-19 features in addition to the other two COVID-19 class characteristics. COVID-19 was distinguished from the other photos by using normal and pneumonia shots at each step, which allowed the network to do so. Medical diagnostics might benefit from the freely accessible training in our network, we believe. Additional data from COVID-19 patients will be accessible in the future, which will improve our suggested network's accuracy.

Finally, even without identifying lesions in CT volumes for training, our weakly-supervised deep learning system exhibited strong COVID-19 detection capacity. For front-line doctors and the global battle against this pandemic, the precision and speed of our algorithm make it perfect for clinical use in COVID19 diagnosis.

The application of deep learning (DL) in chest X-ray and CT imaging was the subject of Ghaderzadeh and colleagues' comprehensive examination of publications published between November 1, 2019, and July 20, 2020. It has been shown that using DL-based models to identify and diagnose COVID-19 reduces the frequency of false-positive and false-negative outcomes, according to this research.

Shi et al. focused on the role of AI in chest CT and CXR in patients with COVID-19. From image capture, segmentation, and diagnosis through follow-up and publicly accessible datasets, they provided an overview of the whole workflow for DL deployment in chest imaging.

Sahlol and colleagues developed an effective hybrid classification system using swarm-based feature selection and a combination of CNNs. This combination should be employed in order to achieve both high performance and minimal resource consumption at the same time. For the massive feature vector provided by CNN, a new method called Fractional-order Marine Predators Algorithm (FO-MPA) was developed. Detailed comparisons of several state-of-the-art feature selection techniques, current CNN architectures, and the most relevant studies and existing classification methods for COVID-19 images were undertaken by the researchers in order to test and evaluate their approach..

III METHODOLOGY

Detailed instructions on how to use the platform may be found here. There are descriptions and examples of the primary components in the architecture, as well as the evaluation measures and calibration metrics used.

There is a major scarcity of resources in every healthcare system. Authenticity and usefulness of research are impacted by the quality of data and research architecture. As previously stated, data availability has an impact on the number of CT scans necessary. This research looked at 6,752 CT images in total. Image processing and artificial intelligence will be used to detect various medical disorders on an AI-based medical center platform. The primary focus of this platform is on challenges related to medical imaging. It looks for and classifies abnormalities depending on the seriousness with which they occur.. This initiative has classified COVID-19 as a priority medical condition..

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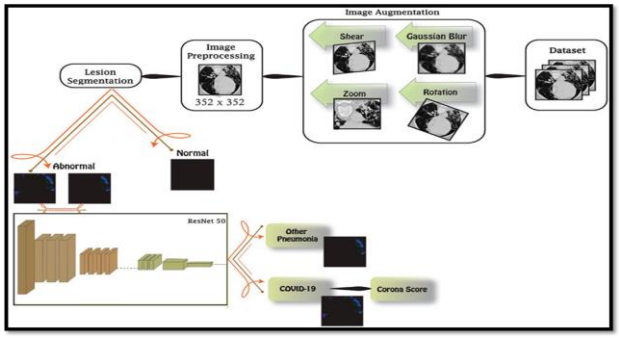


Fig 2 – Block diagram of viruses detection

Enhancing the data begins with the addition of additional images and the identification of distinctive features. This effect is achieved by rotating, shearing, zooming, and blurring images. Standardization and normalizing of the additional data are both part of the pre-processing procedure. To ensure that the network's data is evenly dispersed, several actions are required. The lesion segmentation block leverages InfNet to identify abnormal features and attributes in pre-processed images. By using this block, we can also use image analysis to determine how severe the illness is. The abnormal images are loaded into a deep network using transfer learning, which can distinguish between COVID-19 and other viral pneumonia illnesses. Sections following this one describe each block in great depth.

A. Image Augmentation

Data augmentation is a technique for obtaining more information from an existing dataset. In this case, it creates changed copies of the original images. For the most part, this is done in order to improve the neural network's ability to distinguish between important and insignificant characteristics in the dataset. Numerous methods exist for image enhancement. Augmentation techniques are used successfully when necessary, based on the quality and quantity of information available to researchers. In order to accommodate a wide range of datasets and use cases, we use a variety of approaches, as shown below.

B. Image Pre-processing

The complexity and accuracy of the data cannot be compromised until there is a strategy in place to deal with the data's many sources. Pre-processing photos reduces complexity and improves accuracy. In order to give the network with a clean dataset, this technique goes through many standardization phases. This is an example of a data pre-processing architecture.

• The standardization of pictures is necessary because neural networks that deal with images need images with a single aspect ratio. It is also essential that each picture has its own unique dimensions and a square form, which is often utilized in neural networks.

• Normalization: Normalized data distribution is essential for the training phase of any AI system. By dividing each pixel's mean by its standard deviation, normalization may be achieved. Final consideration is given to scaling normalized data in order to provide beneficial results.

C. Lesions' Segmentation

Ground glass opacities GGOs and consolidation are the most often found characteristics in COVID-19 patients, with 97.86 percent of patients developing such infections within 21 days after COVID-19 was detected in their system. These infections and the infected volume were identified using lesions' segmentation. In this block, the existence of various viral pneumonias will indicate if a picture is normal or abnormal. COVID-19 patients that are normal are delivered to the ResNet block, where they may be detected, while patients who are abnormal are released as output. The segmentation technique makes advantage of the InfNet architecture.

Pareto's famous split ratio will be applied to pre-processed CT scans, as seen in the following figure For the training phase, 80 percent of the dataset's pictures will be used; for testing, around 20 percent will be used.

The pre-processed CT scans are fed into two convolutional layers, which extract low-resolution information. Finally, three convolutional layers are used to extract the high-level features. Edge information has been shown to be valuable during segmentation, hence an edge attention unit is utilized to enhance the display of regions of interest.

Using a parallel partial decoder, a global map of the lung lesions may be created by accumulating the high-level characteristics. By merging output and high-level features with low-level

characteristics, reverse attention units are constructed based on a global map. Finally, an activation function (Sigmoid) is employed to assess the extent of an infection.

The GGO and consolidation phase of a CT scan may be shown using this block of color. If these sections aren't included, the result will be a black image. Visuals that are entirely white are commonplace. In addition, the ResNet50 deep network model is shown more erroneous photographs. Quantifying these representations results in the corona score..

IV ResNet50 Deep Network

An established training method for convolutional neural networks, known as "transferring learning," has a substantial body of research to support it. One way this strategy works is by utilizing ImageNet, a big data set, to train the network before employing it. This solution eliminates the problem of vanishing gradients since the weights of the layers are loaded before to deploying the network. When it comes to transferring knowledge, this is a significant advantage. An further advantage is the capacity to extract crucial learning aspects from images, such as shape and edges. Time is saved in the training process when just the final layers need to be computed

ResNet, an advanced deep learning method, has been shown to beat several dense networks in terms of accuracy and computing complexity.

We used this strategy to distinguish the coronavirus from other viral pneumonia infections.

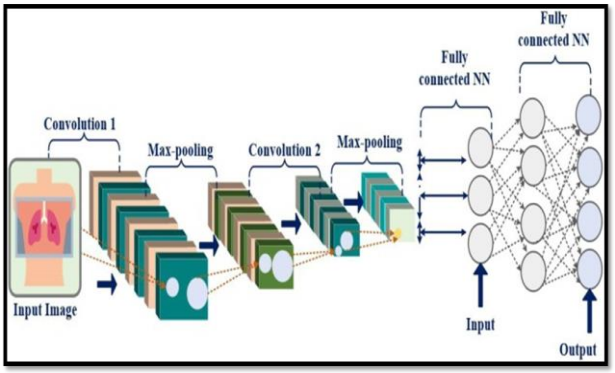
During the pre-trained model's last convolutional layer, the extracted features are saved for later conversion into prediction values specific to each of the dataset's numerous classes. This is known as a classification layer. We'll train this last layer to create estimates using the initialization weights, and then use those estimations to drive the classification process for our fresh set of photos. Models such as this one have extra layers of additional functions including those of the activation and activation functions amongst others (rectified linear unit).

A deep residual network, ResNet50 (50 layers), utilizes the learning rate as an evaluation to update the weights of each layer in this architecture. The weights are modified for each iteration, taking into consideration the loss arising from the input and the predicted values. This table shows the updated formula for calculating weight.

V. The Proposed CNN Model

Both the feature extractors and the classifiers components of the CNN model were used in this investigation. As a consequence, CNN models offer the most accurate results in the categorization of pictures with the least number of mistakes. We employed a CNN architecture similar to the one shown in Figure 3.

Fig 3 – Working of image processing



VI Result

Above images show Covid 19, pneumonia and normal person chest. In this project we detect the Covid 19 affected, pneumonia affected or normal patient using chest x-ray.

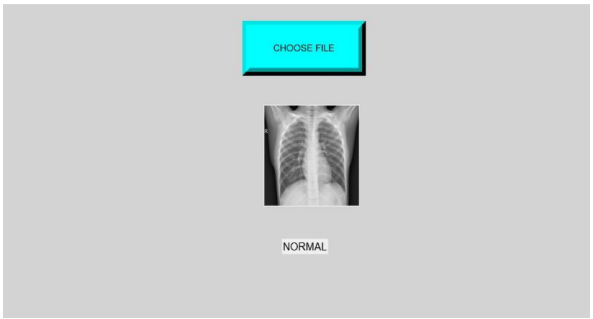


Figure 1 shows that output result of normal chest

Figure 2 shows that output result of chest having pneumonia

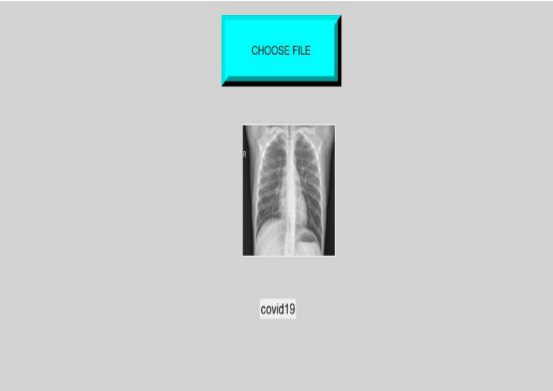


Figure 3 shows that out result of chest having Covid 19

VII CONCLUSION

Segmentation and ResNet deep networks were used in this research to create an improved medical hub architecture. In order to distinguish between healthy and abnormal patients, the first step is to identify any abnormalities in the CT scans. It's this second one that distinguishes COVID-19 instances from those of other respiratory illnesses. Both stages performed well. It was 95.54 percent and 96.5 percent accurate for the ResNet50 block to partition the data into individual blocks. Overall, 95% of the results were correct. As a result of the segmentation block's inclusion, the whole model was found to be trustworthy and to need much less computing time. The severity of COVID-19 cases was also evaluated using a new assessment score that was created in our research (corona score). The virus may be recognized even at a low level of severity, which might lead to an immediate quarantine decision to prevent its spread. COVID-19 detection was the focus of this work, however the platform may be utilized for medical imaging analysis of other disorders as well.

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