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A study on Using CT images and using Deep Learning as part of a classification model for COVID-19 detection

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ABSTRACT:

This research explains how to assess deep TL's efficacy in constructing a classifier for recognising COVID-19 positive patients using CT scan pictures. The research demonstrated that deep learning (DL) is successful in finding COVID-19 cases. Countries are aggressively tackling the COVID-19 virus epidemic as it spreads throughout the world. A COVID-19 detection approach with great sensitivity and efficacy is required to stop it from spreading. This paper proposed a hybrid strategy of image regrouping utilizing ResNet and Densenet employing the COVID-19 chest X-ray photographs as the foundation for its study. The major chest X-ray photographs were utilised to divide the lung region and then separate it into very tiny sections. The extremely tiny components of the lung area were then randomly rebuilt into a normal picture. In addition, the regrouped photos were passed to a deep residual encoder block in order to have their features recovered. In order to avoid the model from becoming too particular and to boost its ability for generalisation, the training dataset is augmented by utilising a data augmentation strategy. We looked at a collection of pre-trained TL models DenseNet and ResNet for Convolutional Neural Networks, which enhanced performance, after preprocessing the data using Contrast Stretching, Histogram Equalization, and Log Transformation.

Key words: X-ray, Histogram, Equalization, Log, Transformation

INTRODUCTION

There has been a remarkable growth in the volume and type of data being utilised in the contemporary world. In the area of automated current diagnostics, the utilisation of huge volumes of data has resulted in substantial advances. Medical pictures must be examined in order to correctly identify and treat illnesses. As a medical diagnostics tool the spectrum of imaging methods utilised in the medical profession is vast, including CT, MRIs, PET scans and ultrasound scans, among others. Devices are necessary for each one of these processes. “CT scans, for example, are created by CT scanners, which employ a revolving X-ray tube to gather measurements from different angles and a computer to translate the information into CT scans”[1]. It's no surprise that CT scans generated by several manufacturers (e.g. Siemens, Fujifilm, GE Healthcare) tend to be uneven. The difficulty is aggravated even more by the employment of diverse scanning procedures. Figure 1.1 clearly displays the variations between providers. This shift may take some time to get adjusted to even for an experienced radiologist who has been trained for it in the past.

The (COVID-19)[1] Illness has spread throughout the world, impacting practically every part of human existence. COVID-19 is found via a range of scientific methods, including (RT-PCR)[2] and isothermal amplification of nucleic acids COVID-19 is now the most extensively deployed technique of detection. Because of sample contamination, damage, or viral modifications in the COVID-19 genome, there is a significant incidence of false alarms[3].

19 virus COVID (SARS-CoV-2)[4] affects individuals and healthcare globally. Advanced screening technology is needed to quickly isolate and treat COVID-19-infected individuals. RT-PCR may identify SARS-CoV2 in upper respiratory tract mucus samples[5]. COVID-19 screening is a specialized approach, however its sensitivity varies by sampling method and sickness duration. Few investigations have indicated that COVID-19 is sensitive [6]. Since RT-PCR testing is time-consuming, test results may be delayed (Figure 1).

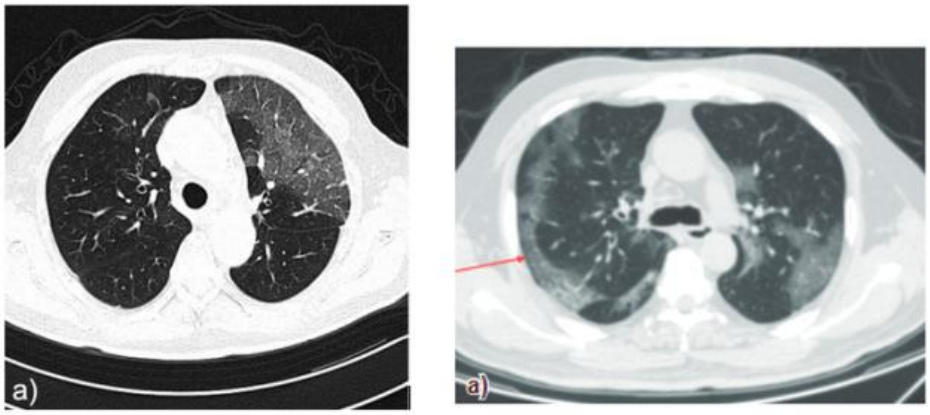

Figure 1: "CT scans produced by different vendors can differ in quality.

Because of their sensitivity, chest scans have been considered as a COVID-19 screening tool, and they may be particularly effective when combined with RT-PCR[7]. CT imaging was extensively employed during the early COVID-19 pandemic. Cost and resource restrictions limit repeated CT scans for COVID-19 detection[8].

In recent years, the quantity of studies presenting machine learning for categorisation has exploded. Medical picture categorization is automated. Deep neural networks (DNNs) are utilised to classify CT images for respiratory illness diagnosis [9]. Reliable training data are needed for accurate diagnosis. The previously highlighted problem of data variance is now a challenge. In an industry where neural network decision might affect a person's life, this is crucial. Since misclassification is unacceptable, homogenous training data is needed.

Simulation Tool
Python.

PROPOSED METHODOLOGY

Contrast Stretching (CS)
COVID-19 was identified using a CNN-based model established by researchers. The recommended model has 27 layers and has been evaluated using X-ray, CT, and MRI images. They utilised 70 percent of the data for training and 30 percent for testing against the second dataset in the studies. On X-ray, CT, and MRI, the recommended model's weighted average accuracies are 94 percent, 85 percent, and 86 percent, respectively. Many tests illustrate the model's relevance in comparison to state-of-the-art works.

Histogram Equalization (HE)
A histogram of the picture may help with addressing the dark phases. It is possible to use a histogram to identify whether a picture is bright or clear, whether it has a low difference, or whether it has a high separation colour. Histogram A histogram is used to do some levelling on the picture. The aesthetic value of an image may be enhanced with the use of this technique. This involves chopping up pictures into smaller and smaller pieces. The histogram is connected to measuring pixel values for the darker levels of the image, which have dim levels or power that fall anywhere in the range of 0 to 255.

Log Transformation
Log transformation is a technique for altering data that requires replacing a log value for each variable x. This approach is referred to by the phrase "log transformation." (x). The logarithm foundation of the research will, in the vast majority of instances, be selected in accordance with the objectives of the statistical modelling. In the acronym, "ln" stands for "nature log," which may also be written out. We could log convert the data if it does not fit the bell curve in order to make it as "normal" as is reasonably feasible, which will boost the validity of the conclusions of the statistical research. This will be done in order to make the data as "normal" as is realistically possible. In other words, the log transformation brings the degree of distortion in our original data down to a more manageable level or completely eliminates it.

ResNet
As can be observed in Figure 2, an entirely new design was implemented for the residual neural network as compared to the conventional CNN architectures. It features gated units, which make it possible to pass through certain connections. One of its primary functions is to ensure that batches are normalised. As a consequence of this, the ResNet-20 is able to train NN models with as much as 152 layers. The use of numerous layers in conventional CNNs may result in a large increase in complexity; however, this is not the case with ResNet's architecture. This

Convolutional Neural Network (CNN) is among the best performers due to its minimal complexity and 3.57 percent error rate across datasets.

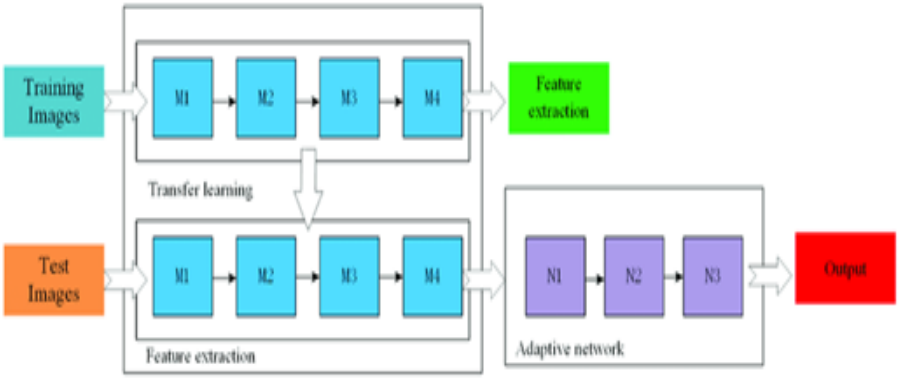

Figure 2- Figure showing the basic architecture of ResNet.

EXPERIMENTAL ANALYSIS

Dataset Collection-The clinical study produced data from CT scans of SARS-CoV-2, with a total of 2482 CT images. The information was collected from several hospitals located in Sao Paulo, which is located in Brazil. This collection contains pictures that have been digitally scanned copies of printed CT scans, however the image sizes have not been defined. We utilised the COVID 19 x-ray image dataset, which included classifications for both COVID and NON-COVID. There were 1252 pictures in the covid class and 1229 images in the non-covid class.

Data pre-processing-Pre-processing methods may be helpful in many aspects of digital image processing, including the elimination of unwanted noise, the localization of important parts of an image, and even the deep learning training phase. The height and width of an image need to be adjusted so that they are proportional to the existing aspect ratio. The image filtering pre-processing approach reduces the size of all input pictures to the smallest possible amount. The original images are preprocessed in a unique manner by each of the programmes. Following that, ResNet and DenseNet models were used to the pre-processed pictures in order to train them. Figure 3 displays the original picture together with its histogram for your viewing pleasure. Figures 4 and 5 show the pre-processed sample image as well as the image's histogram following contrast stretching. Figures 6 and 7 show the pre-processed sample image as well as the image's histogram following log transformation. Finally, figure 8 shows the pre-processed sample image as well as the image's histogram following histogram equalisation.

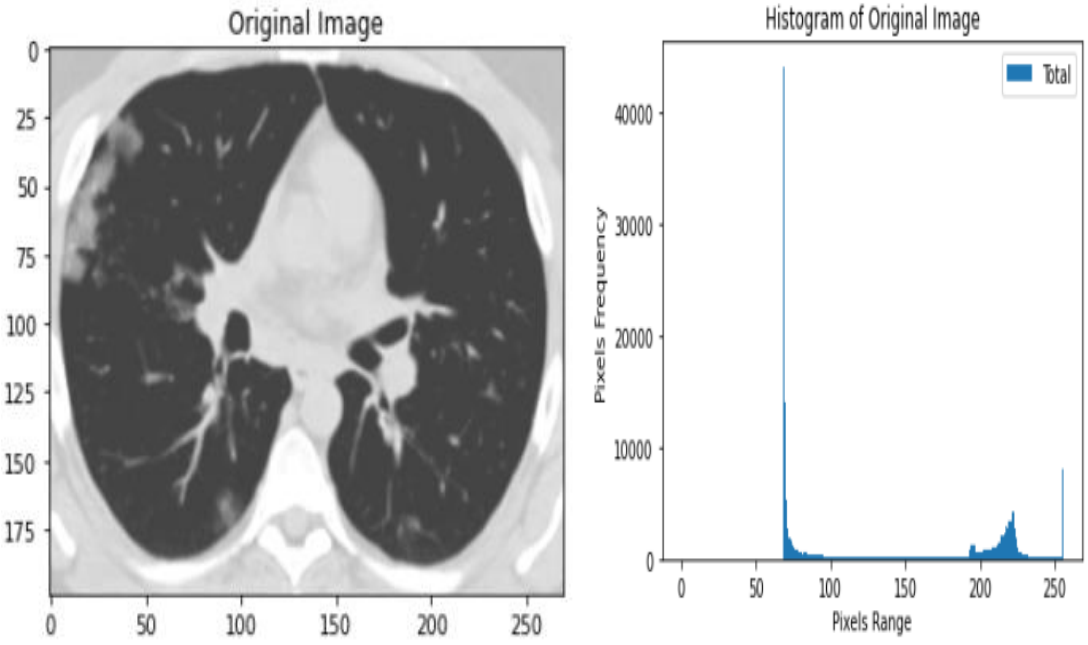

Figure 3- The figure shows the original image and the histogram of the original image.

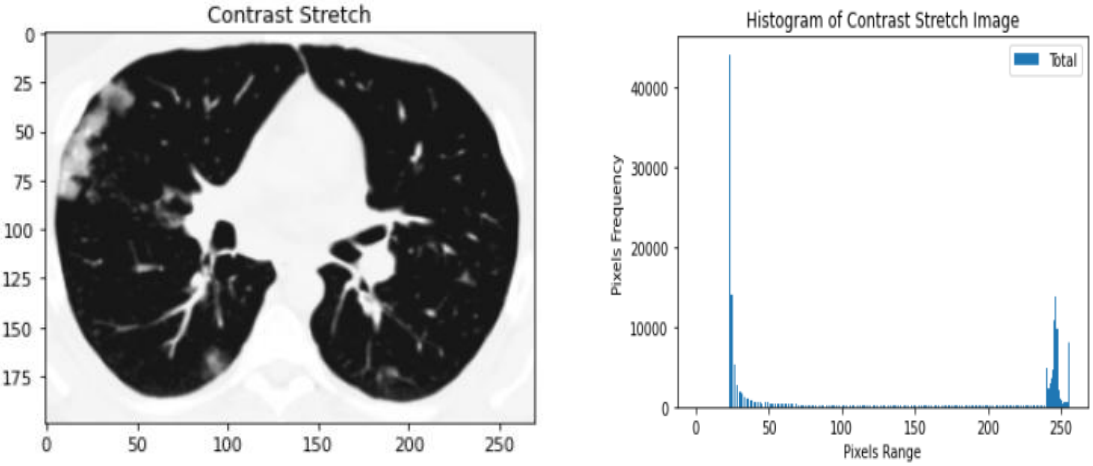

Figure 4- The figure shows the CS image and the histogram of the CS image.

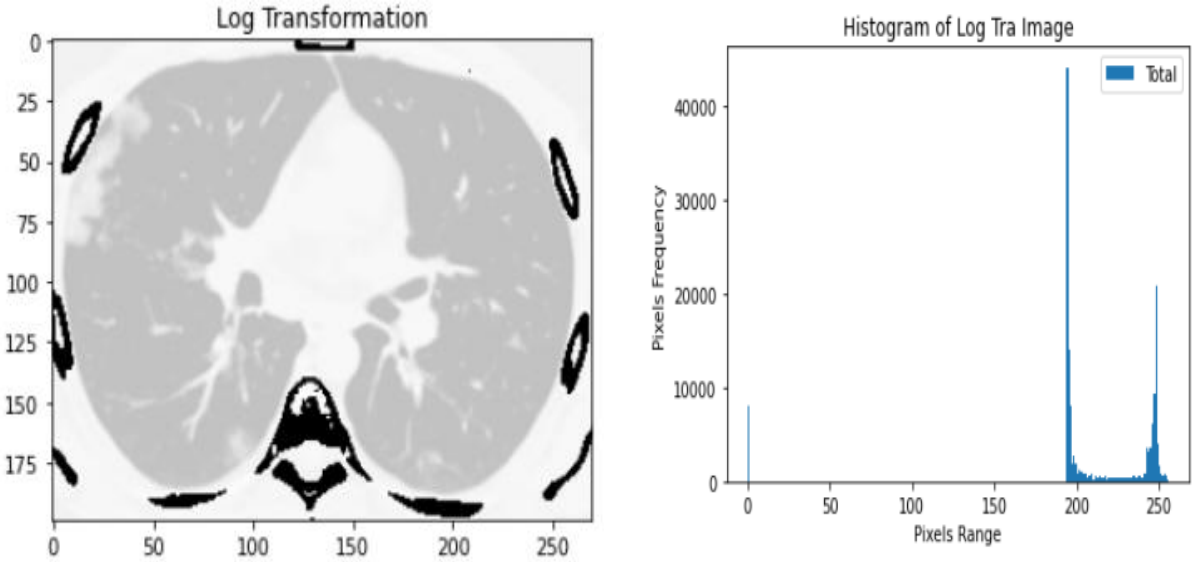

Figure 5- The figure shows the LT image and the histogram of LT image.

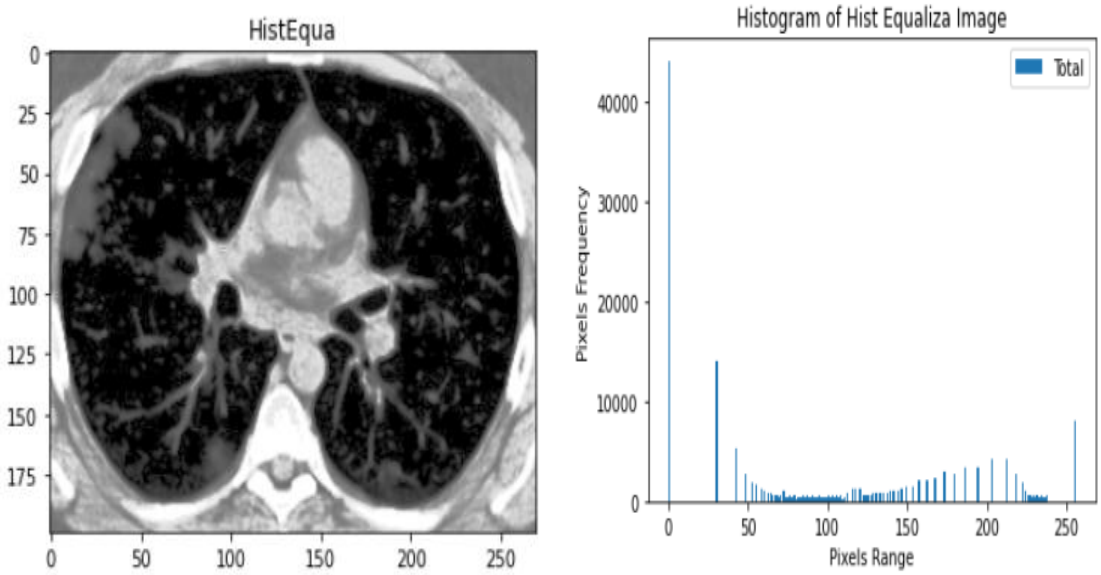

Figure 6- The figure shows the HE image and the histogram of the HE image.

Following the use of a variety of preprocessing techniques, the final dataset should be prepared for training with the ResNet and DenseNet models. We begin by generating random pathways for each picture, after which we establish a data frame for each class. The frequency histogram of each class is presented in the figure for the purpose of doing the analysis of each class.

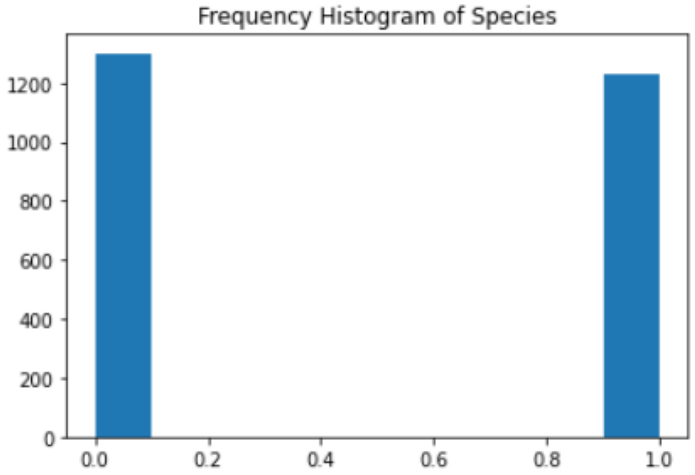

Figure 7- The figure shows a histogram of different species of classes.

CONCLUSION

COVID-19 is ongoing globally. There are now more publicly available datasets and DL-based categorization and prediction algorithms. This research presents DL approaches for COVID-19 detection in human lungs. These patterns classify COVID-19 and patient situations. The research used CT scans to identify COVID-19 illness. These photos were used to train and evaluate DenseNet and ResNet-based classification algorithms. Identifying and classifying pictures is a key job in computer vision. Pattern recognition and machine learning research is active. Forming and researching items requires time for service providers and clients. Sorting and labelling takes time. Large dataset training needs time and processing resources. Picture recognition can be done at any level of ML image processing without human intervention. This research examines picture categorization using an imaging backend. A few thousand fashion photographs were separated into training and test datasets for our learning model. The research found that photos are accurately recognised even when comparable pictures are jumbled, cropped, or rotated to generate an original input. The algorithm works. Training and analysing classification techniques have improved with TL. We combined DenseNet121 with Resnet101.

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