

Computational Analysis of Radiographic Images of chest of COVID-19 Patients & its predictions using AI

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Abstract - With the exponentially growing COVID-19 (corona virus disease 2019) pandemic, clinicians continue to seek accurate and rapid diagnosis methods in addition to virus and antibody testing modalities. Because radiographs such as X-rays and computed tomography (CT) scans are cost-effective and widely available at public health facilities, hospital emergency rooms (ERs), and even at rural clinics, they could be used for rapid detection of possible COVID-19-induced lung infections. Therefore, toward automating the COVID-19 detection, we propose a viable and efficient deep learning-based chest radiograph framework to analyze COVID-19 cases with accuracy. A unique dataset is prepared from available sources containing the chest view of CT scan/X-ray data for COVID-19 cases. Our proposed framework leverages a data augmentation of radiograph images algorithm for the COVID-19 data, by adaptively employing the MATLAB and NeuroSolution on COVID-19 infected chest images to generate a train a robust model. The training data consisting of actual and synthetic chest images are fed into our customized neural network model, which achieves COVID-19 detection with good accuracy. Furthermore, through this it is possible to efficiently automate COVID-19 detection from radiograph images to provide a fast and reliable evidence of COVID-19 infection in the lung that can complement existing COVID-19 diagnostics modalities.

Index Terms - MatLab, Neuro Solution Software, Microsoft excel, Various Transform Technique

1. INTRODUCTION

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), first observed in Wuhan, China, turned into a global pandemic of COVID-19 (coronavirus disease 2019). COVID-19 has a destructive impact on the well-being of people, particularly senior citizens and patients with underlying health conditions and compromised immunity levels. By 28th May, 2021, the COVID-19 pandemic already contributed to over 35.1 lac mortalities and more than 19.6 crore million cases of COVID-19 infection. A critical step in the fall of 2021, preparedness to combat such scenarios will involve increasing use of portable chest CT scan / X-ray devices due to widespread availability and reduced infection. Therefore, as depicted in Fig.1, to automate the COVID-19 detection using machines, we aim to develop an artificial

intelligence (AI)-based smart chest radiograph for COVID-19 cases with accuracy.

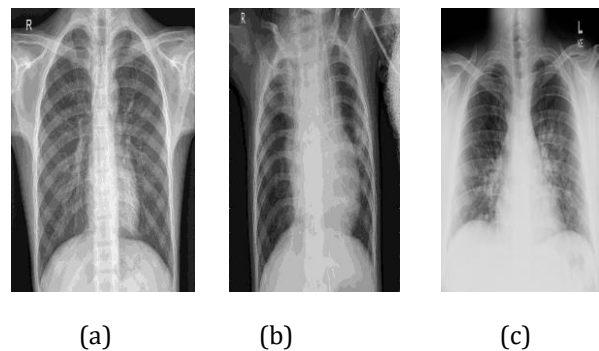


Fig.1. Three sample of X-ray images, (a) Normal, (b) Pneumonia, (c) Covid

2. RESEARCH METHODOLOGY

NurbaitySabri , RaseedaHamzah , Shafaf Ibrahim &KhyrinaAirinFariza Abu Samah [1] has analyzed a total of 101 data consist of 33 COVID-19, 28 normal and 40 bacteria of chest X-Ray images are tested. The extracted features are tested using Weka software where it able to analyze the accuracy of k-NN classifier using 10-folds cross-validation. The result represents with true positive (TP) and false positive (FP) for all tested images. In their research, 3776 attributes from x-ray images have been used for classification purpose. Matrices used to measure the efficiency of the classifier precision and recall. Precision represent the percentage of x-ray images that are classified as true. Meanwhile, recall is the percentage of relevant x-ray images that labeled as "true" by the classifier Result of classification. Based. They have clearly observed that LBP able to produce a good classification accuracy with average of 0.960. 96%. The analysis also reveals that the maximum precision and recall are obtained for the LBP algorithm, with both values at 0.96. SadmanSakib, TahratTazrin, Mostafa M. Fouda, Zubair Md. Fadlullah And Mohsen Guizani [3] proposed DL-CRC framework consists of two parts: the DARI algorithm (which adaptively employs a customized generative adversarial network and generic data augmentation techniques such as zoom and rotation) and a two-dimensional convolutional neural network (CNN) model. They employed a unique dataset for multiple publicly

available sources, containing radiograph images of COVID-19 and pneumonia infected lungs, along with normal lung imaging. The classification accuracy significantly increased to 94.61% by adopting our proposed DL-CRC framework. They have compared their proposal with existing deep learning models from di-verse categories such as depth-based CNN (e.g., Inception-ResNet v2), multi-path-based CNN (DenseNet), and hybrid CNN (ResNet) architectures. Extensive experimental results demonstrated that their proposed combination of DARI and custom CNN-based DL-CRC framework significantly out-performed the existing architectures. Thus, incorporating the proposed model with significantly high accuracy into the clinical-grade as well as portable X-ray equipment can allow an automated and accurate detection of COVID-19 in the scrutinized patients.

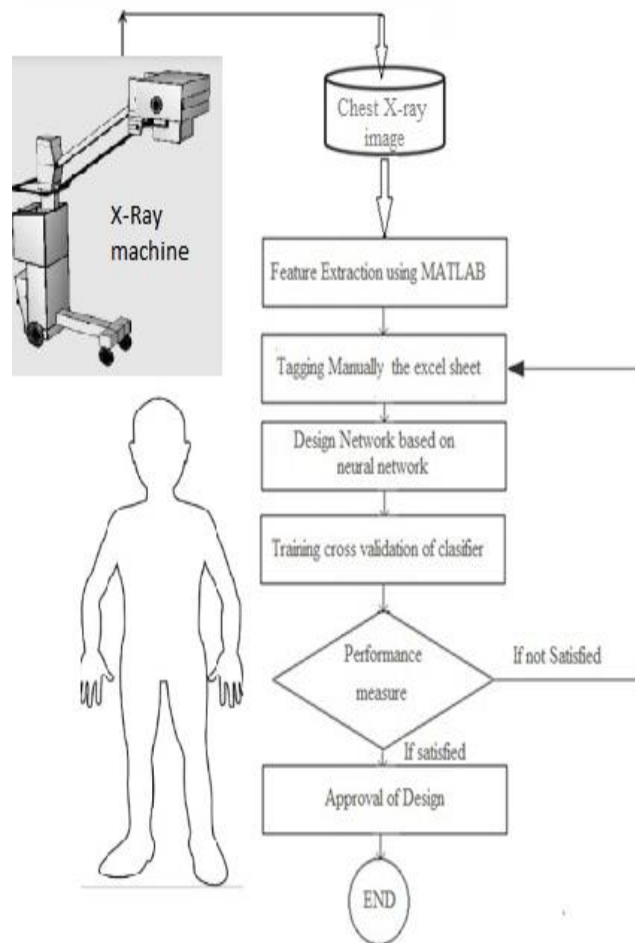


Fig 2: Flow Chart

It is proposed to think about the grouping of three dataset images Using Neural Network Approaches.. Information securing for the proposed classifier intended for the Recognition of three type of dataset images .The most vital un corresponded includes and in addition coefficient from the images will be extricated . In order to extract features, statistical techniques, transformed domain will be used.

Computational Intelligence techniques include the following will established techniques.

- i) Statistics
- ii) Learning Machines such as neural network .
- iii) Transformed domain techniques such as FFT, WHT, HISTOGRAM etc.

For choice of suitable classifier following configuration will be investigated.

- i) Support Vector Machine.
- ii) Modular Neural network.
- iii) Generalized Feed Forward Neural Network

For each of the architecture, following parameters are verified until the best performance is obtained.

- i) Train-CV-Test data
- ii) Variable split ratios
- iii) Retraining at least five times with different random initialization of the connectionweights in every training run.
- iv) Possibility different learning algorithms such as Standard Back-Propagation, Conjugategradient algorithm , Quick propagation algorithm, Delta Bar Delta algorithm, Momentum
- v) Number of hidden layers
- vi) Number of processing elements of neurons in each hidden layer.

After regions training & retraining of the classifier, it is cross validated & tested on the basis of the following performance matrix.

- i) Mean Square Error
- ii) Normalized Mean Square Error
- iii) Classification accuracy
- iv) Sensitivity
- v) Specificity

In order to carry out the proposed research work, Platforms/Software's such as Matlab, Neuro solutions, Microsoft Excel will be used.

3. SIMULATION RESULTS

Pre-processing:

- ❑ Pre-processing and image enhancement operations on images are carried out to improve the quality of image data and to remove distortions.
- ❑ We have to analyze information in the image so as to improve the quality and reduce distortions.
- ❑ First, image data is transformed to gray scale using threshold technique then gray scale image is converted to black and white image using binarization. Conversion from a gray-scale image to a black-and-white image may cause some loss of information.

INPUT OF COVID-19 X-RAY DATASET



Fig 3: COVID-19 X-RAY DATASET

INPUT OF PNEUMONIA X-RAY DATASET



Fig 4: PNEUMONIA X-RAY DATASET

INPUT OF NORMAL X-RAY DATASET

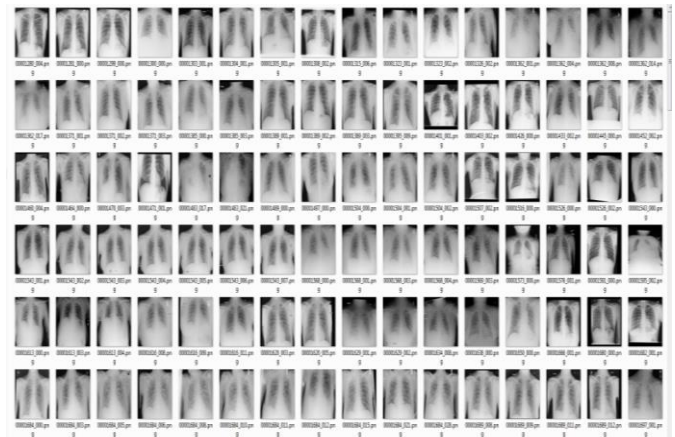


Fig 5: NORMAL X-RAY DATASET

ANN TRAINING

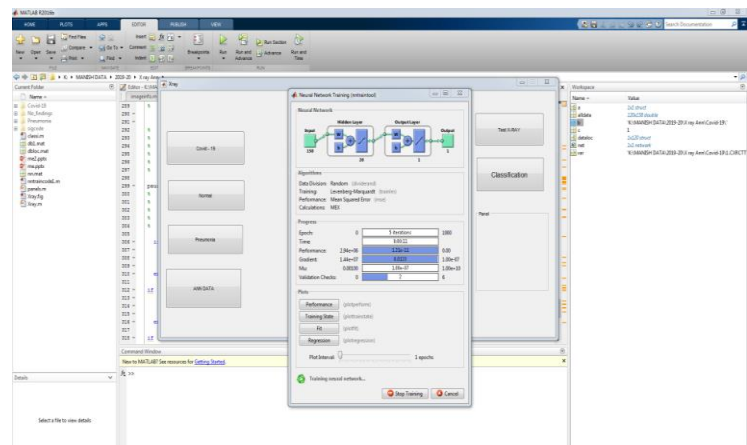


Fig 6: ANN TRAINING

Classification of X-RAY Image

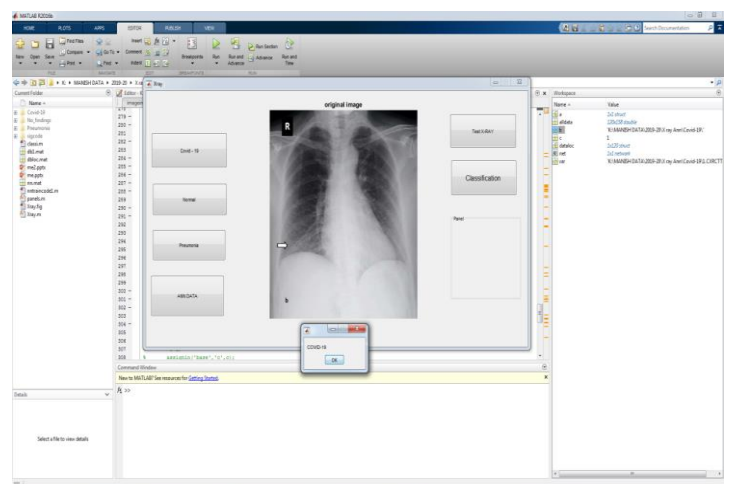


Fig 7: Classification Of X-RAY Image

NeuroSolutions Results

NeuroSolutions provides an easy-to-use and intuitive user interface for Microsoft Excel. It simplifies and enhances the process of getting data into and out of a NeuroSolutions neural network. It also benefits both novice and advanced neural network developers by offering an easy-to-use, yet extremely powerful and exclusive features. The Excel interface is accessible by clicking on the "Launch Excel with NeuroSolutions" button from the launcher OR by launching Excel directly.

Importing Data in Excel

Excel provides the perfect interface for presenting data for neural networks. It can work with any column-formatted data such as comma-separated files (.csv), tab-delimited files (.txt) and of course Excel files (.xls and .xlsx).

Segmentation of Image

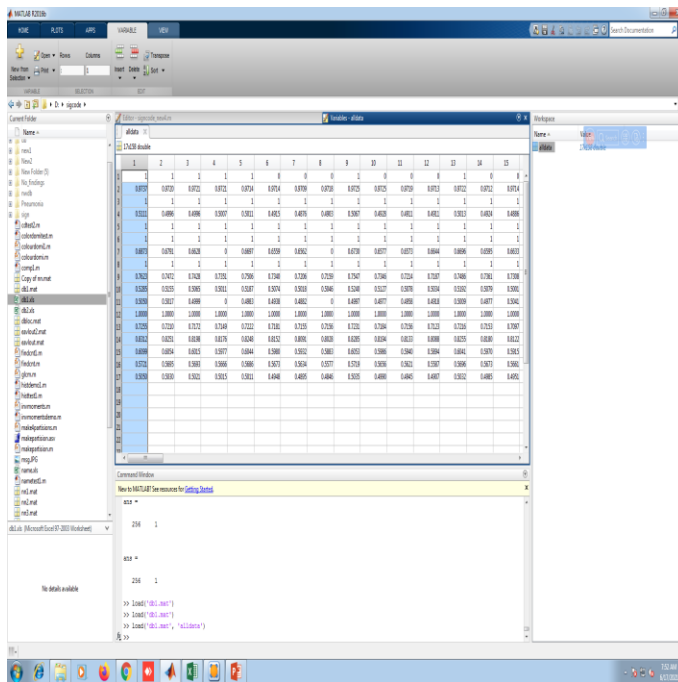


Fig 8: Importing data in Excel

Data export to Excel

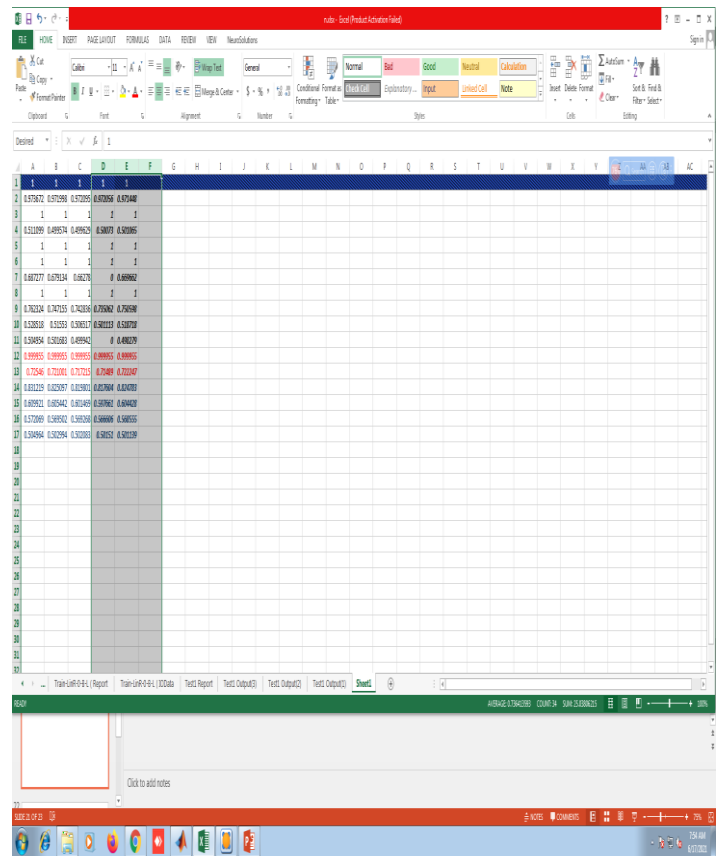


Fig 9: Exporting data to Excel

Neurosolutions Process

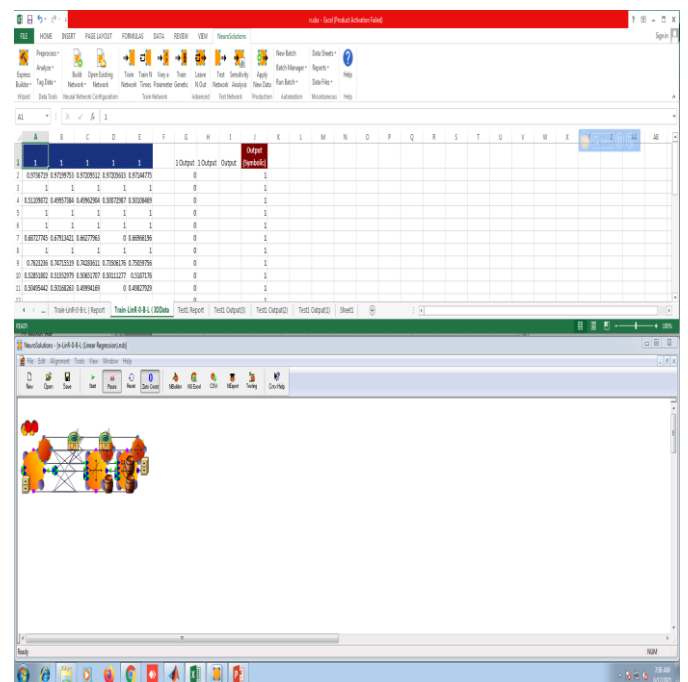


Fig 10: Neurosolutions Process

Neurosolutions Test Report

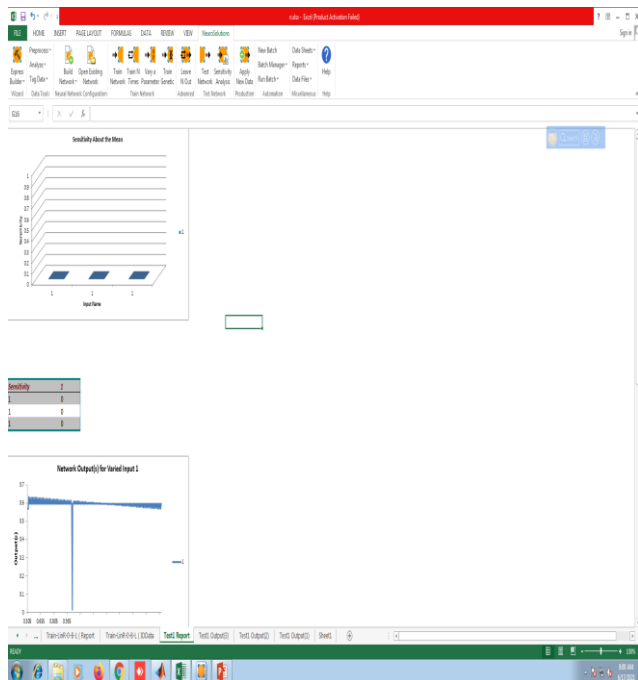


Fig 11(a): Neurosolutions Test Report

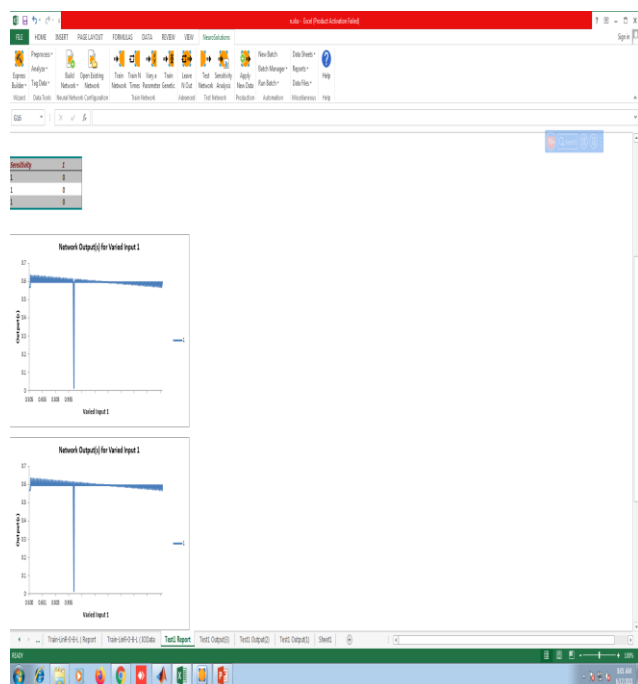


Fig 11(b): Neurosolutions Test Report

4. CONCLUSIONS

Fast and timely detection of Covid +ve patients are necessary to avoid spreading of the disease and keeping it in control. This research work has been done to detect the Covid +ve patients from Chest X-Ray images in a simple and inexpensive way. In the work proposed in this paper,

three-state-of-the-art deep learning models have been adopted and ensembled. The proposed model has achieved a classification accuracy of 95.7%. Even more important fact is it has given a sensitivity of 98% i.e. out of 100 Covid +ve patients, 98 can be correctly diagnosed by our proposed model. It is believed it will help the doctors to detect the affected patients with the help of computer-aided analysis. The accuracy of the system can be further improved through rigorous training and cross-validation. These systems may also be realized in hardware system on chip after thorough validation and the systems can be deployed in different hospitals.

5. ACKNOWLEDGEMENT

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