WEB Predictor COVIDz: Deep Learning for COVID-19 Disease Detection from chest X-rays

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***Abstract* - While writing these words, the number of COVID-19 infected persons exceeded 20 730 456 and caused 751 154 deaths across the world as reported by WHO (World Health Organization) statistics [1]. The matter has become a reality and the damage is very severe, there is no longer any way to save humanity from this epidemic except diagnose and prevention, especially with the delay in the emergence of any vaccine recognized by the World Health Organization so far. Without therapeutic treatment or explicit restorative immunizations for COVID-19, it is fundamental to distinguish the malady at a beginning phase and to have the option to quickly seclude a contaminated patient. This study, therefore, looked at the diagnostic value and consistency of chest imaging.**
Access to imaging is not always possible, accessible, or feasible. Our application solves this problem and from a WEB Predictor COVIDz and a program with deep learning we will be able to systematically bring the chest X-ray image and predict the percentage of absence or presence of COVID-19. The proposed approach (Custom VGG model) and our WEB site COVIDz objective validation of the suggested solution obtained the best classification efficiency 99,64%, F-score of 99,2%, Precision of 99,28%, MCC of 99,28%, recall of 99,28%, and a Specificity value of 100%.

Index Terms - COVID-19, Diagnosis, Chest X-ray, Deep Learning, VGG model, Convolutional Neural Network.

I. Introduction

In our days, if someone has a fever, dry cough and fatigue or even body Nasal irritation, fever, conjunctivitis, sore throat, nausea, loss of taste or odor, rash, or decoloration of hand fingers or foot, the first thing will jump to your mind is COVID-19. As of late, another identified virus, originating from the severe acute respiratory syndrome coronavirus2 (SARS-Cov-2) family gives the impression that is profoundly undermining for human life's [2]. Among CoV family including six infections subtypes, middle east respiratory syndrome (MERS)-CoV and SARS-CoV contribute to human respiratory disorders, and slow reacting substance of anaphylaxis (SRS-A) dampers the activity of human cilia. Furthermore, extreme respiratory difficulties are linked to CoV disease and breathing problems can lead to pneumonia, kidney problems and fluid accumulation in human lungs [3].

Especially after it was officially announced as a global pandemic by WHO and the spread of true and false news about how it spreads, and based on the number of infections and that of deaths, most patients (about 80%) recover without the need to be hospitalized. In terms of symptoms disease, about one in five people with the disease has difficulty breathing as severe symptoms. Older people and those with other medical issues (heart, hypertension, diabetes or malignancy) are bound to have genuine side effects [10]. Be that as it may, anyone and all will get COVID-19 and get seriously ill. However, people of any age who develop a fever and/or cough associated with difficulty breathing, chest pain/pressure, or loss of speech or difficulty moving should seek medical attention immediately [3].

WHO nor suggest self-prescription with any medicine, including antibiotics, to forestall or fix COVID-19, neither examinations have had options to illustrate the efficiency of current drugs to prevent or treat the disease, it was necessary to find a simple technological means to be used in all hospitals or by individuals who have not received any trainings in the field of health in order to detect this disease, especially in remote areas and developing countries. This is exactly what we focused our research on, to finally come out with software that can detect the virus in chest tomography scans. It returns the result, either infected or not, with a mention of it certainty on the result.

This paper is structured accordingly: Methods and materials are described in Section 2 and Section 3 respectively, with deep learning models and experimental set-up parameters. In Section 4, success indicators evaluations are comprehensive. Section 5 provides debate and conclusions derived from the proposed models. Finally, it outlines the interpretation and possible research.

II. Methods and Materials

A. Python

Python is a programming language of high general purpose that was initially being mainly received as a screenplay for general purposes and was widely used as a web programming and script language of choice. Over the last decade, it may be an excellent resource for the academic programming world, and the language has been explosively extended in research and data processing applications since then [11].

B. VGG-16

Several works [4- 9] are aimed at detecting the presence of the COVID, we used the well-known and powerful neural network model, the VGG-16. This network was developed during a competition set up by the ImageNet organization and which aims to classify the content of images into 1000 everyday objects (sheep, hen, fork, castle, lamppost, various dog breeds…). The VGG-16 was developed in 2014 and achieved the score of 92.7% accuracy. It did not win the competition but stood out for its particularly good results given its very light architecture. The model shown below is a CNN network model proposed by K. Simonyan and A. Zisserman [12]. It makes it possible to reach 92.7% on the ImageNet database which contains 14 million images belonging to 1000 classes.

C. Dataset

In this work, the GitHub Open Source Repository has collected images of COVID-19 patients [13]. Our study was based on a dataset of 279 pictures of 139 COVID-19^{+} and 140 COVID-19^{-} patients. The size of each image was 128x128 pixels in this dataset.

Figure 1 offers an allocated chest X-ray for COVID-19^{+} patients and COVID-19^{-}. The dataset was randomly divided into two independent, 80% and 20% data sets for both training and testing.

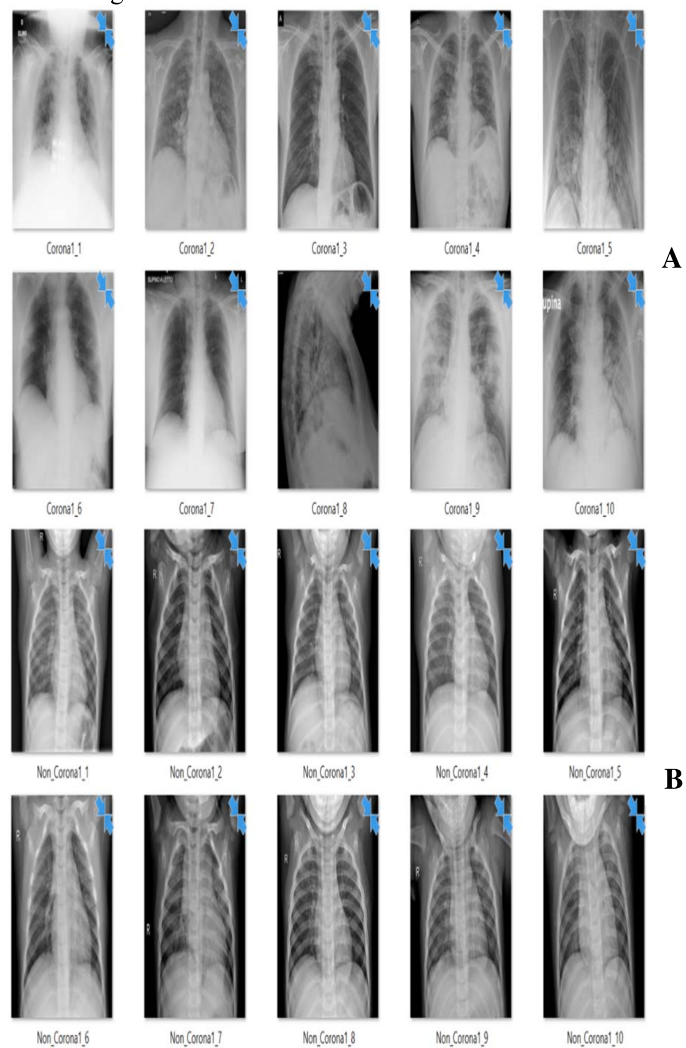


Fig.1. (A) Representative chest X-ray images of "COVID-19^{+}" patients, (B) Representative chest X-ray images of normal "COVID-19^{-}" [13].

D. Classification

Deep Learning is a part of machine learning that is enlivened by the usefulness of a human cerebrum and is viewed as valuable for learning complex issues. Also, CNN is a sort of Deep Learning, which has indicated prominent execution in identification, characterization, and division assignments [14].

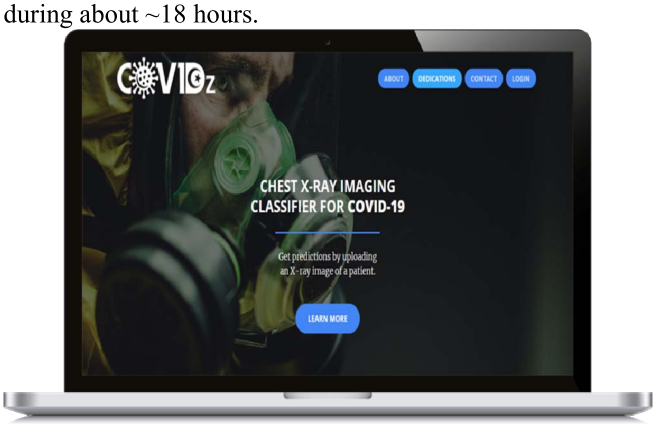
It is additionally revealed that CNN indicated promising outcomes in clinical applications, where a lot of information is accessible. Be that as it may, CNN"s execution might be influenced when an adequate measure of information isn't accessible. Particularly in clinical picture applications, there might be few marked pictures accessible. Along these lines, the TL idea is generally abused to accomplish significant execution on a modest quantity of information, and it likewise diminishes the computational cost [15, 16]. During the preparation cycle, the system gets data from the pre-prepared framework through the TL method.

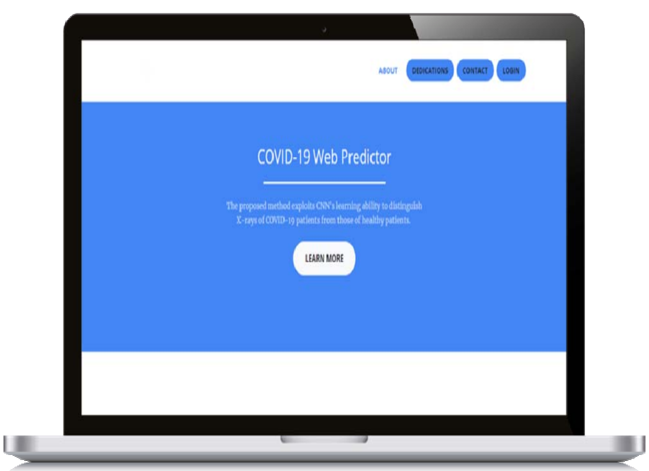
E. Implementation Details

As of now, the COVID-19 dataset is having restricted named tests, and in this way, we abuse TL based tweaked pre-prepared systems for separating COVID-19$^-$ from COVID-19$^+$ tainted patients, CNN system that we utilized is VGG [17- 23].

III. Experimental Setup

All simulations were carried out on the Anaconda Prompt framework in a Toshiba (TM) i7-6600U CPU with a 2.80 GHz processor; the results as well as the display will be on a WEB browser. The training of the models were approximately took during about ~18 hours.





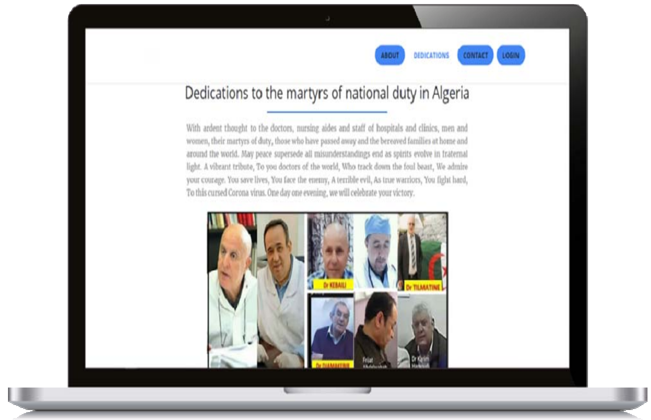


Fig.2. X-ray Imaging Classifier COVID-19 Home Page

After accessing the COVIDz, users will have to log in or register on the site if they do not have an account before, as shown in Figure 3:

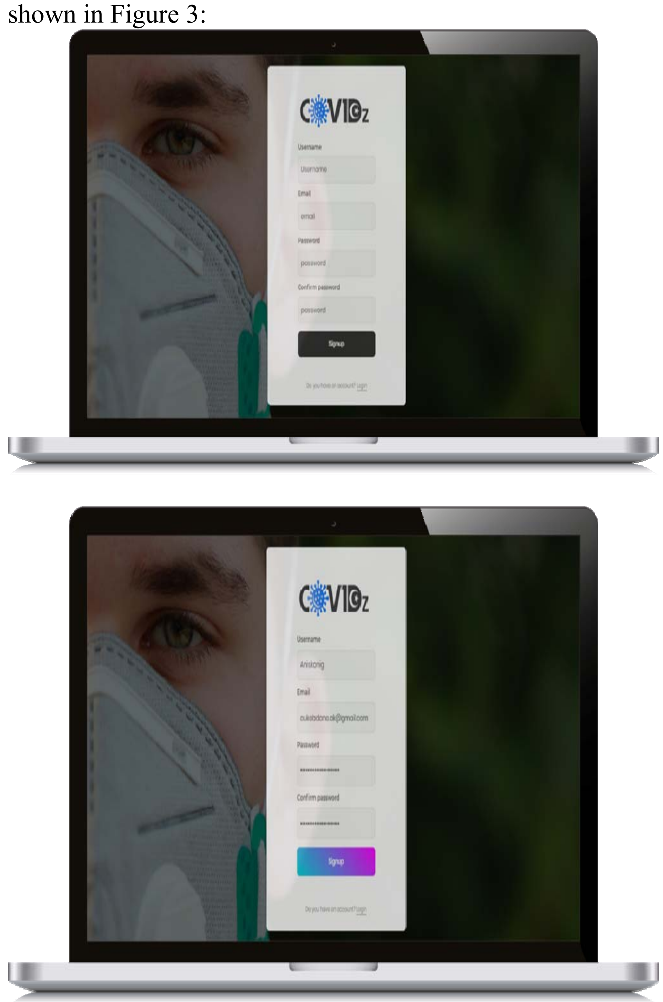


Fig.3. Registration with personal information on the COVIDz

After having accounts, only registered users can carry out the forecasting process by clicking the "Take a COVID-19 Test" button (Figure.4).

Fig.4. Main page for subscribed users

All that's left to do is download X-ray image, as done below in Figure.5.

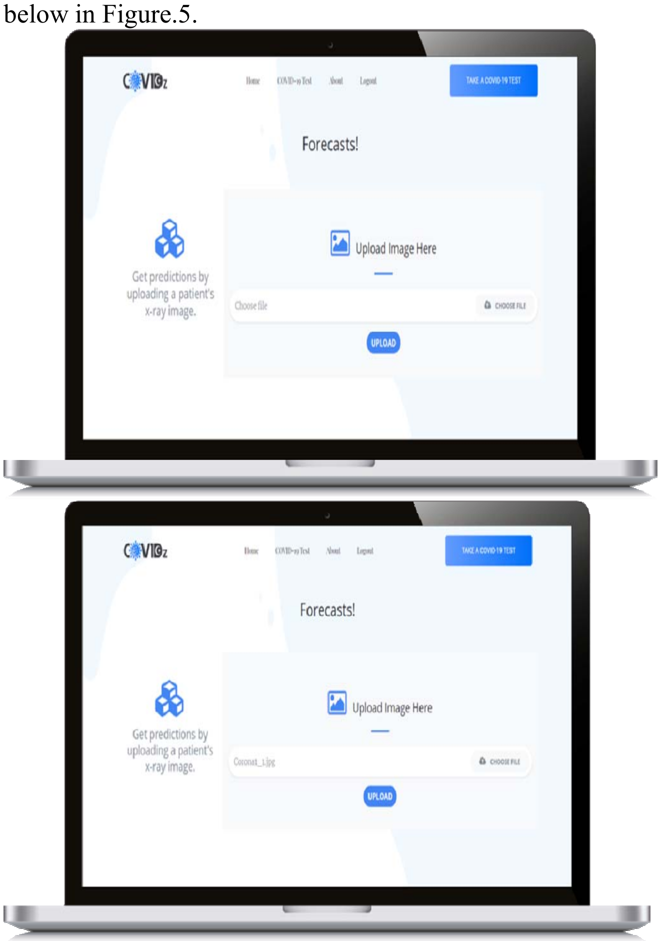


Fig.5. Prediction page

Then the image is analyzed and the results will be displayed on the interface and also sent via the e-mail that was used during registration, Figure 6 and 7 below illustrate such as approach.

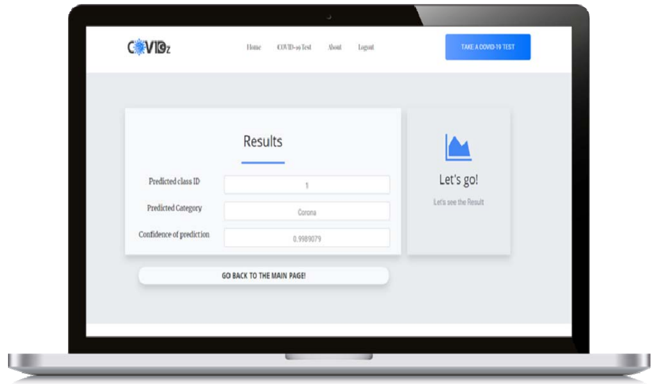


Fig.6. Prediction result of an x-ray image; Fig.7. Automatic mail sending with details and some advices to be taken

IV. Performance Evaluation

For deep transfer learning models, six parameters have been used. Our method shows relevant results and measured quality metrics, including precision, sensitivity, specificities, recall, F-score and Mathews Correlation Coefficient (MCC). The confusion matrix is represented in Fig.7.

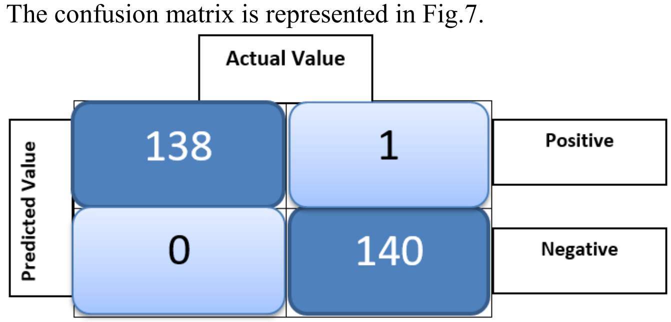


Fig.7.Confusion matrix for COVIDz on the test dataset

For a detailed visual analysis, the results given in Fig.8, show some results from 279 chest X-ray images from the Dataset [13] with our predicted probability. Misclassified or unreasonable predictions sometimes can rely on reasonable explanations. By the aid of the class activation, we can investigate useful knowledge of the prediction regions. The probability values of the predictions are nearly 1.00 (whether for Positive (Red) or Negative (Green) cases). As it can be observed, the model used has high predicted anomaly probability scores for Positive/Negative patients.

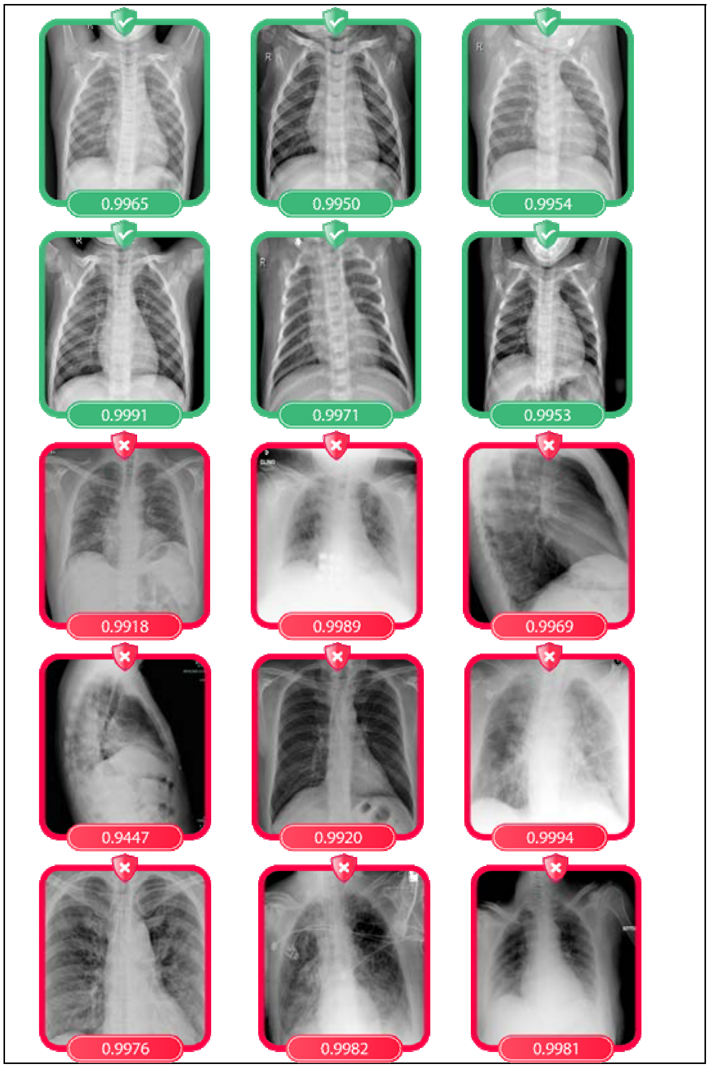


Fig.8. Some results from the 279 chest of the X-ray. Underneath every picture is the predicted score. The top row (green) shows negative cases, and the bottom row (red) shows Positive cases.

After calculating all of the gained parameters, the results are listed and compared in Table 1, below.

TABLE 1
PERFORMANCE METRICS COMPARISONS

Networks	Acc	F-sco	MCC	Prec	Spe	Recall
Alexnet	50	0.66	--	100	--	50
VGG19	91.67	0.91	0.83	93.33	93.33	90.32
Google Net	88.33	0.88	0.77	86.67	87.10	89.66
Inceptionv3	95	0.95	0.90	100	100	90.91
Resnet18	95	0.95	0.90	100	100	90.91
Resnet50	95	0.95	0.90	100	100	90.91
Squeeze Net	78.33	0.80	0.58	90	86.96	72.97
DenseNet201	95	0.95	0.90	100	100	90.91
COVID-RENet	96.67	0.97	0.94	100	100	93.75
COVIDz	99,64	0,992	0,992	99,28	100	99,28

A deep CNN model for separation of patients with COVID-19+ from people using chest X-rays is created, while carrying out this study. Table.1 provides extensive performance comparisons on all the CNN models of the resulted tests, with excellent performance relative to those with the exactness of the proposed approach model (accuracy of 99,64%, F-score of 99,2%, Precision of 99,28%, MCC of 99,28%, recall of 99,28%, and a specificity value of 100%, as Table.1 shows). Furthermore, a few pre-processing strategies are utilized to augment execution in a fair test set.

Our solution is not just used only by a lab technician or an authorized person, single Centralized Data, technologies like Deep Learning and AI is used so that x-ray can be classified and detection of infected area automatically.

V. Conclusion and Future Works

In the present article, we have proposed interpreting and examining Chest X-ray images for a broad CNN grouping method for the differentiation of COVID-19^{+} patients. Several clinical trials have shown that chest radiological images can track and monitor people affected by COVID-19. CNN's are incredible and powerful calculations that take explicit highlights in space from images using the algorithm of rear-propagation calculation [24, 25].

Chest images of COVID-19 patients have explicit marks, for example, Opacities of ground glass, rounded anatomy and peripheral distribution of the lung. Therefore, by extracting we graded the X-ray images the proposed model with efficient deep feature hierarchies.

The possible reason behind the improvement of the model is the coordinated use of normal and maximum concentration in the CNN architecture and the use of efficient calculation tools, such as python and JavaScript. We're going to try Three various network based neural models (Like ResNet50, InceptionV3 and Inception-ResNetV2) in our future works.

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Conflict of Interest

The authors has no conflict to disclose.

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