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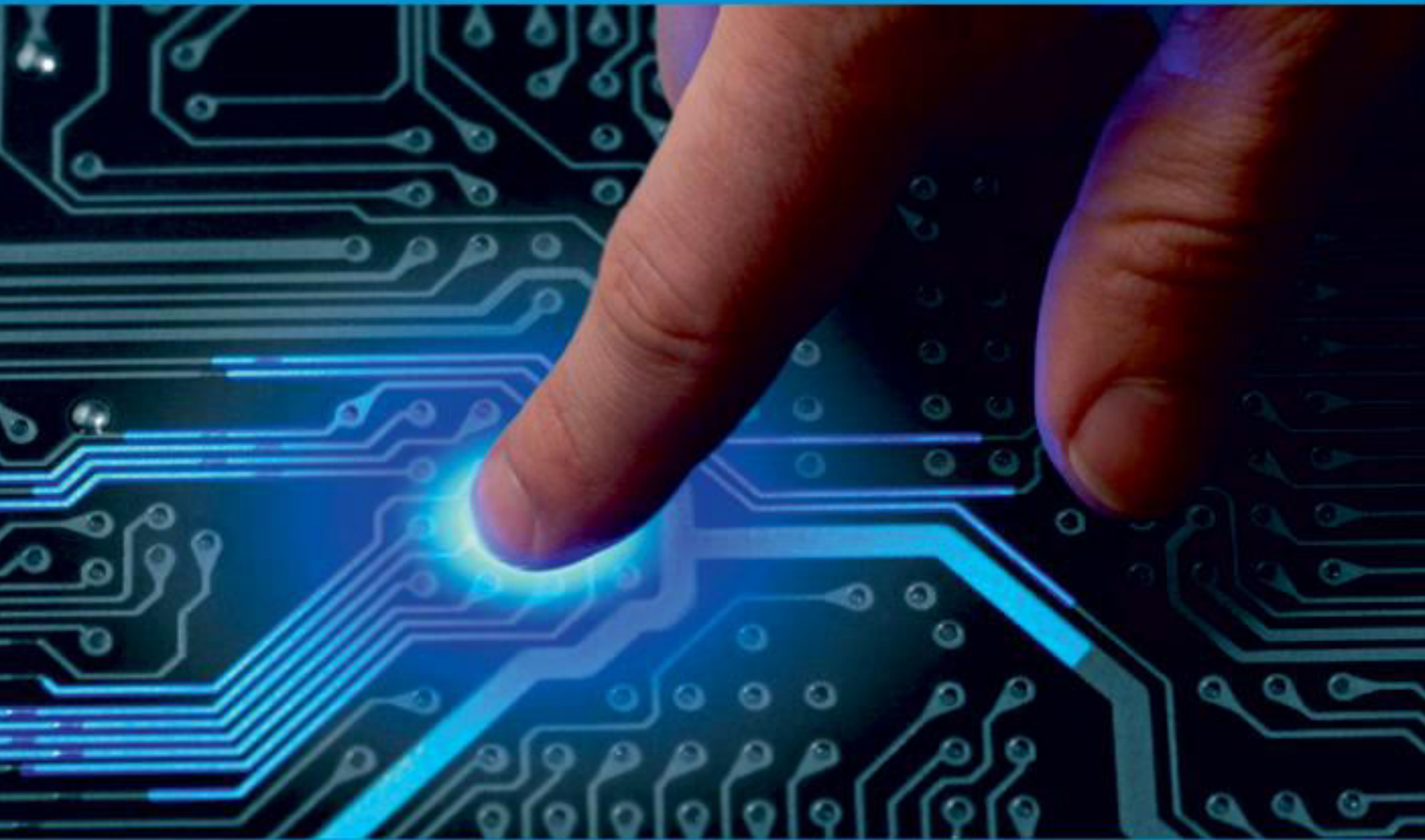

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Artificial Intelligence Based Diagnosis of Covid-19 Patients Using Chest X-Ray Scans

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ABSTRACT: Corona-virus (COVID-19) is an infectious disease. The main challenge in fighting against this disease is its scale. Due to the outbreak, medical facilities were under pressure due to case numbers. The most used testing mechanism was the RTPCR(Real Time Reverse Transcription–Polymerase Chain Reaction). The visual detection of the abnormalities on the Chest X-Ray (CXR) or the Computed Tomography (CT-Scan) were very determinant and helpful in identifying the virus among the vast population and the diagnosis process was quite significant and result oriented. Significant attention has been given to detection and diagnosis tools with rapid diagnostic tools based on X-rays using deep learning being proposed. Here, we present an evaluation of several well-known pretrained deep CNN models in a transfer learning setup for COVID-19 detection from chest X-ray images.

KEYWORDS: COVID-19, Chest X-ray scans, MobileNetv2, ImageNetPre, Machine Learning

I. INTRODUCTION

In March 2020 after spreading of covid-19, to more than 100 countries and leading to several thousands of cases, the World Health organization (WHO) officially declared the outbreak of the new coronavirus as a pandemic[1].To stop the spread of COVID-19 virus and to protect vulnerable people, many countries worldwide performed diagnostic tests to key staff and the general population to detect COVID-19 positive cases[8].The diagnosis of COVID-19 is performed by the reverse-transcription polymerase chain reaction (RT-PCR) test.The diagnosis of COVID-19 is performed by the RT-PCR test after collection of proper respiratory tract specimen, which is a laboratory-based test for detection and quantification of a targeted DNA molecule [2]. The RT-PCR test can be done only in laboratories that are equipped with the needed infrastructure.[5] Moreover, in some cases the COVID-19 test may need be repeated after one or two days while the cost of the equipment and the required PCR reagents is not low, thus making this diagnostic test expensive[7] and sometimes time consuming, without counting the need for specialized microbiologists to do the tests analyses and the appropriate safety measures (personal protective equipment) that are required to keep laboratory staff safe [6]. Due to these difficulties and restrictions many countries are restricting the performed diagnostic tests for COVID-19 to only suspicious cases and/or vulnerable groups of population as it is not possible to do massive testing of the general population[3].Based on the above-mentioned facts, the development of alternative, complementary and low-cost tools for detection of COVID19 positive cases and for decision making support is essential[4].

In this paper, we present an evaluation of several pretrained deep convolutional neural network (CNN) models on the detection of positive cases the new COVID-19 virus from chest X-ray images.

II.COVID-19DETECTION FROM X-RAY IMAGES

Detecting Covid-19 from X-ray images is a challenging task as the disease can have similar manifestations as other respiratory diseases, making it difficult to differentiate visually. However, there are several methods that have been developed for automated detection of Covid-19 from X-ray images. Here are some of the techniques:

1) Deep learning-based methods: Deep learning is a subset of machine learning that uses neural networks

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with multiple layers to learn features from the input data.Several deep learning-based methods have been proposed for Covid-19 detection from X-ray images. These methods typically use convolutional neural networks (CNNs) to extract features from the images and classify them as Covid-19 positive or negative.

2) Transfer learning: Transfer learning is a technique where a pre-trained neural network is used as a starting point for training a new model on a different dataset.This approach has been used for Covid-19 detection from X-ray images where pre-trained CNNs are fine-tuned on Covid-19 X-ray images.
3) Ensemble methods: Ensemble methods involve combining multiple models to improve the overall performance.For Covid-19 detection, ensemble methods have been used to combine several CNN models to improve the accuracy of the detection.

It is important to note that X-ray imaging should not be used as the sole diagnostic tool for COVID-19. Other diagnostic tests such as RT-PCR should also be performed to confirm the diagnosis. In addition, it is recommended that any automated or AI-assisted diagnosis be validated by a trained medical professional to ensure its accuracy and avoid any false positives or false negatives that could lead to incorrect treatment decisions.

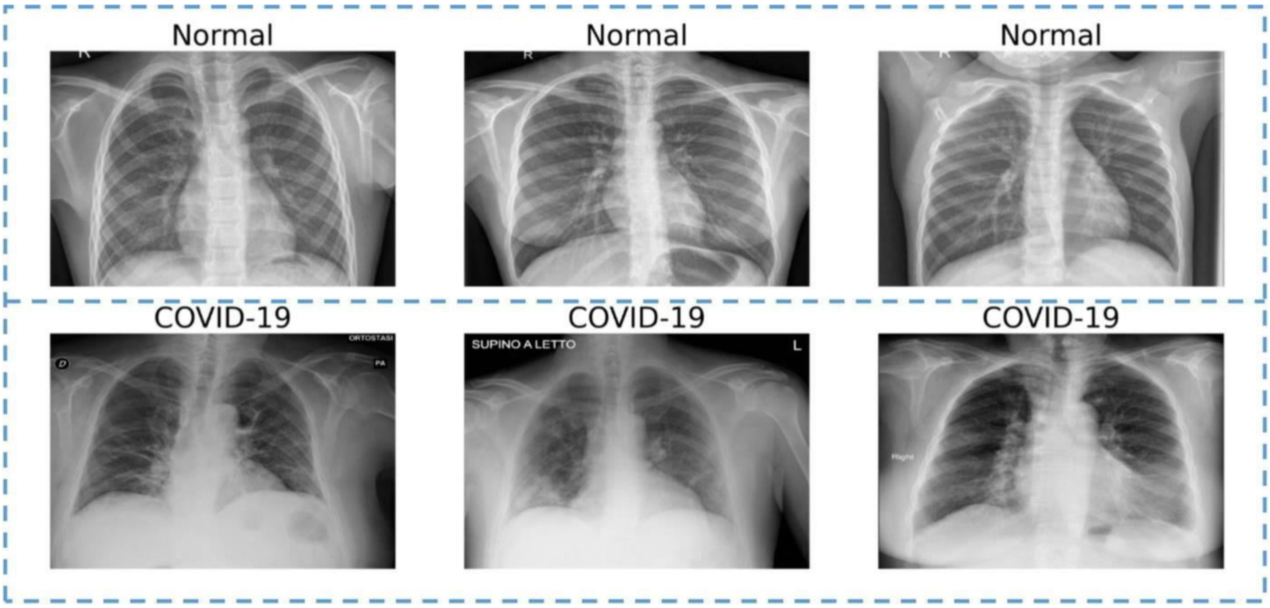

Fig.1: Chest X-ray images of covid-19 and normal persons

III. PROPOSED MODEL

COVID-19 positive cases detection is performed using convolutional neural networks. In particular, we used well known deep CNN models for classification of images which have are pre-trained from large image databases and retrained them to learn COVID-19 positive vs negative cases.Chest X-ray images which have been clinically diagnosed as COVID19 positive are pre-processed and afterwards are used to retrain existing deep CNN models for image classification.X-ray images pre-processing consists of image resizing and pixel values normalization to meet the input specifications of each pretrained deep CNN model. The CNN models are retrained as binary classifiers to identify positive COVID-19 against non-COVID-19 chest X-ray images. The retrained deep CNN models and used for testing, receiving as input new chest X- rays with unknown clinical diagnosis in order to automatically label them as positive COVID-19 cases or not, i.e., providing a binary decision per chest scan.This approach of using pre-trained deep CNN models for COVID-19 detection in chest X-ray images is a promising method for automated diagnosis of COVID-19. By utilizing pre-trained models, it is possible to leverage the vast amount of data in these large image databases, which can improve the accuracy and efficiency of COVID-19 detection.Pre-processing the chest X-ray images by resizing and normalizing pixel values can help to ensure that the input specifications of the pre-trained deep CNN models are met, which is important for accurate classification.The block diagram of the evaluated architecture for detection of COVID-19 positive cases from chest X-ray images.

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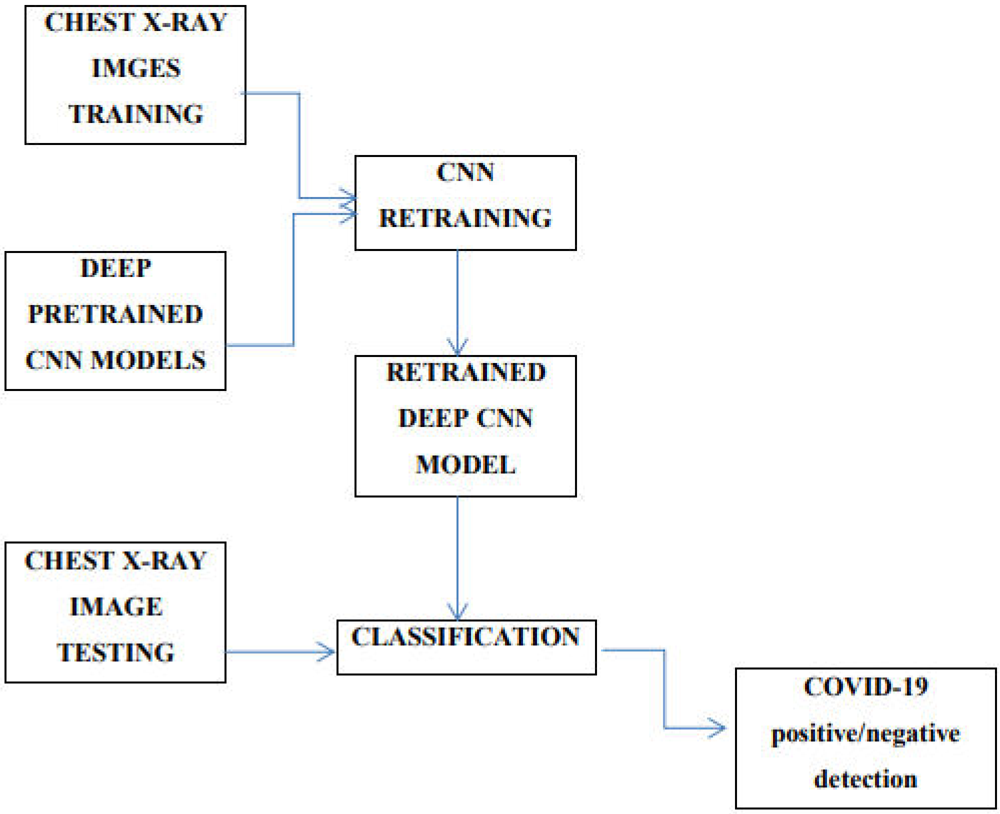

Fig.2: Design Methodology

IV. RESULTS

These are two performance metrics for a machine learning model that has been trained and validated on a dataset. The training accuracy of 0.96875 means that the model correctly predicted the label of 96.875% of the training samples in the dataset. The validation accuracy of 0.9583333134651184 means that the model correctly predicted the label of 95.833% of the validation samples in the dataset. After the entire testing of the images in the dataset the loss we get is minimal.

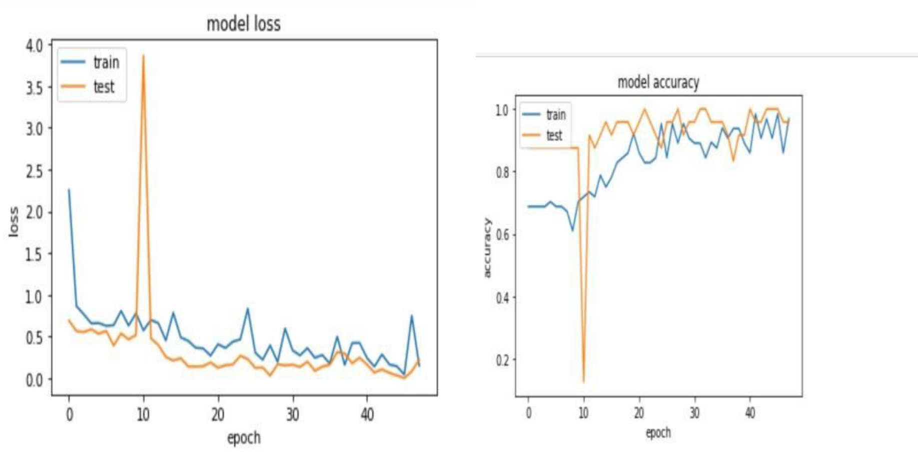

Fig.3: Graphs of accuracy and loss

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A confusion matrix is a table that is often used to evaluate the performance of a classification model. It shows the number of true positives (TP), false positives (FP), true negatives (TN), and false negatives (FN) for each class in the dataset. The value of true positives is 21 which is near to 20 and is depicted by yellow in show bar and true negatives is 8 and is depicted by dark green colour in show bar.

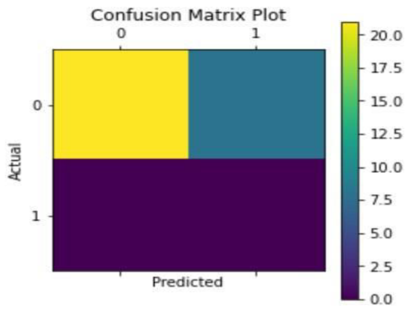

Fig.4: Confusion Matrix

This is a summary of the training and validation performance of a machine learning model over 5 epochs. The model is a neural network, as indicated by the use of the terms "loss" and "accuracy", which are commonly used in the context of training neural networks. Each epoch represents a complete iteration through the training data, during which the model learns to make better predictions by adjusting its internal parameters. The training and validation performance is reported after each epoch. The "loss" metric represents the difference between the model's predictions and the actual labels in the training data. A lower loss indicates that the model is making more accurate predictions. The "accuracy" metric represents the proportion of correctly classified samples in the training data. In this the model starts with a loss of 0.3670 and an accuracy of 0.8533 in the first epoch. As training progresses, the loss decreases and the accuracy increases, with the model achieving a loss of 0.1172 and an accuracy of 0.9610 in the final epoch. After training, the model is evaluated on a validation dataset consisting of 1250 samples, and we don't have information about the performance metrics on this evaluation

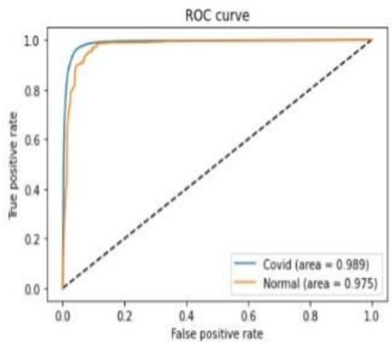

Fig.5: Area under ROC curve (AUC)

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V. CONCLUSION

In this model, we were able to generate an accuracy of 96.80% and area under the ROC (AUC) of 96.10%. And we also compared several models like MobileNetv2 and ImageNetPre with our model and found that our model outperforms MobileNetv2 and ImageNetPre on our specific task and dataset.

MODEL	ACCURACY	AUC
MobileNetV2	0.8572(85.72%)	0.816(81.6%)
ImageNetPre	0.755(75.50%)	0.892(89.20%)
PROPOSED MODEL(CNN)	0.968(96.8%)	0.9610(96.1%)

Table.1: Comparison of proposed model to other model

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