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COVID-19 Detection Using Chest X-Ray Images

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Abstract: The sudden increase in COVID-19 patients is overwhelming healthcare systems across the world. It is difficult to test every patient with COVID -19 symptoms due to limited testing kits (RT-PCR) available. The tests take long time, and they have limited sensitivity. Detecting COVID-19 infections using Chest X-Ray will help quarantine high risk patients while test results are awaited. In this work we use the chest X-Ray to prioritize the selection of patients for further process. It will also be useful where the to decide whether to keep the patient in the ward along with other patients or isolate them in COVID-19 areas. It is also useful in identifying patients with high likelihood of COVID with a false negative RT-PCR who would need to undergo repeat testing again.

Keywords: COVID-19, RT-PCR, severe acute respiratory syndrome coronavirus 2 (SARS-CoV- 2)

I. 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 mid-July 2020, the COVID-19 pandemic already contributed to over 570,000 mortalities and more than 13 million cases of COVID-19 infection.

A critical step to combat the pandemic is to effectively detect COVID-19 infected patients as early as possible so that they may receive appropriate attention and treatment. Early detection of COVID- 19 is also important to identify which patients should isolate to prevent the community spread of the disease. However, considering the recent spreading trend of the COVID-19,an effective detection remains a challenging task, particularly in communities with limited medical resources. While the reverse transcription polymerase Chain reaction (RT-PCR) test-kits emerged as the main technique for COVID-19 diagnosis, chest X-ray (chest X-ray), computed tomography (CT) scans, and biomarkers are also being increasingly considered by many nations to aid diagnosis and/or provide evidence of more severe disease progression.

Motivated by this, several researchers and sources recommend the use of chest radiograph for suspected COVID-19 detection. Therefore, radiologists can observe COVID-19 infected lung characteristics by harnessing non-invasive techniques such as CT scan or chest X-ray. However, it is difficult to differentiate the COVID- 19-inicted features from those of community acquired bacterial pneumonia. Therefore, for many patients, manual inspection of the radio-graph data and accurate decision making can be overwhelming for the radiologists, and an automated classification technique needs to be developed. In addition, radiologists may get infected and need to isolate that may impact rural communities with a limited number of hospitals, radiologists, and caregivers. Moreover, as the second wave of COVID-19 is anticipated in the fall of 2020, preparedness to combat such scenarios will involve increasing use of portable chest X-ray devices due to widespread availability and reduced infection control issues that currently limit CT utilization. There-fore, as depicted in above fig, to automate the COVID-19 detection using X-ray images, we aim to develop an Deep Learning based Chest Radiograph Classification for COVID-19 Detection to distinguish the COVID-19 cases with high accuracy from other normal cases.

II. OBJECTIVE

- In this study a deep learning model is proposed for the automatic diagnosis of COVID-19.
- Our system consists of Convolution Neural Network (CNN) model capable of detecting COVID and non COVID patients.
- The encouragingly high classification accuracy of our proposal implies that it can 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.

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III. LITRATURE REVIEW

Most nations had to take measures to react to the sudden and rapid outbreak of COVID-19 within a relatively short period of time. Radiology departments have started to focus more on preparedness rather than diagnostic capability, after sufficient knowledge was gathered regarding COVID-19. The study stated the resemblance of COVID-19 with other diseases caused by other coronavirus variants such as the severe acute respiratory syndrome (SARS) and the middle east respiratory syndrome (MERS). The importance of a tracking the lung condition of a recovering coronavirus patient using CT scans was also mentioned in the study. Chest imaging techniques were highlighted to be a crucial technique for detecting COVID-19 by capturing the bilateral nodular and peripheral ground glass opacities in the lung radiograph images.

The application of AI, for early detection, diagnosis, monitoring, and developing vaccines for COVID- 19. Several research work exist in the literature that exploited various deep learning techniques on X-ray data to demonstrate reasonable performance . A model, referred to as Dark Covid Net, for early detection of COVID-19 was proposed which utilized 17 convolutional layers to perform binary and multi-class classification involving normal, COVID, and pneumonia cases. While the model reported an overall accuracy of 98.08% for the binary classification and 87.02% for multi-class classification, our reconstruction of the Dark Covid Net using multiple datasets indicated overtraining and much lower accuracy when non- biased test data are presented to the model. Several other papers applied deep learning models on CT scan images to detect and monitor COVID-19 features in the radiograph data. . In employed implemented the state-of-the-art CNN architectures such as Alex Net, ResNet-18, ResNet-50, Res Net- 101, Squeeze Net, VGG-16, VGG-19, Mobile Net- V2, Google Net, and Xception CT to differentiate between COVID-19 and non-COVID-19 cases. Their experiments showed that deep learning could be considered as a feasible technique for identifying COVID-19 from radiograph images. To avoid poor generalization and overfitting due to lack of COVID-19 samples in available datasets, a GAN model was used to generate synthetic data, which achieved a dice coefficient of 0.837. The applicability of GAN for COVID-19 radiograph data synthesis can be confirmed from the broader spectrum of GAN applications on various medical data according to the survey. The survey identified various unique properties of GAN such as domain adaptation, data augmentation, and image-to-image translation that encouraged researchers to adopt it for image reconstruction, segmentation, detection, classification, and cross-modality synthesis for various medical applications.

IV. PROPOSED METHODOLOGY

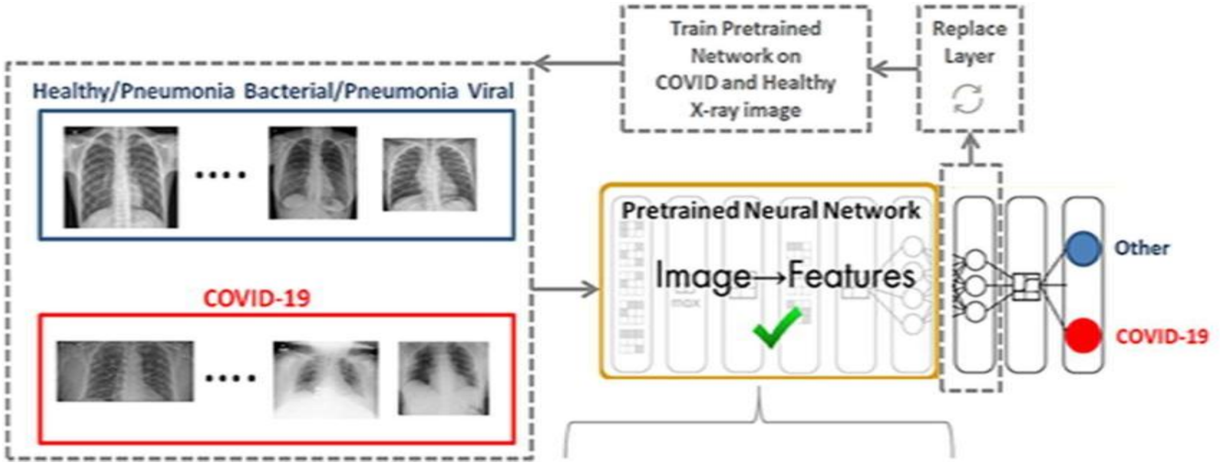

Fig : Block Diagram

The bellow steps are followed

1. Data Acquisition: A total of 1000 Chest X- Ray images were collected from public databases available on various GitHub repositories. Among these, 400 were of COVID-19 positive patients and 600 were of patients who did not have the virus. Images were classified as COVID-19 and Non- COVID-19.
2. Data Splitting: The ratio used to divide the dataset into training and testing sets was kept at 75:25. For training 750 records were used and 250 were used for testing. The validation set is kept as 30% of the training set.
3. Data Preprocessing: The image which is in jpg or jpeg format is fed to the pre-processing unit where RGB to Gray conversion takes place and the image is resized at 1:1 ratio (100/100).
4. CNN: Next, we need to train a deep learning model which can take advantage of the robust dataset obtained from our proposed algorithm. Since the problem can be regarded as a classification task of normal, COVID-19, and

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other abnormal cases (e.g., pneumonia), we investigate the contemporary deep learning architectures suited for classification. In contrast with other variants of deep learning architectures. CNNs are regarded as the most powerful deep learning architecture for image classification. Therefore, we explore the robust CNN models recently employed to gain reasonable classification accuracy with chest X-ray data.

By applying the contemporary CNN models on the latest dataset compiled from four public repositories, we realize that their reported performances are constrained by overfitting and influenced by biased test data. To address this issue, we propose a two- dimensional (2-D), custom CNN model for classifying X-ray images to predict COVID- 19 cases.The 2-D CNN structure is utilized to learn the discriminating patterns automatically from the radiograph images. The proposed CNN model consists of three components. The first component is a stack of nc convolution layers while the second segment consists of nd fully connected layers. The final component is responsible for generating the output probability. At first, the convolution layers (i.e., the first component of the model) receive radiograph images (X) as input, identify discriminative features from the input examples, and pass them to the next component for the classification task. Each ith layer among the nc convolution layers consists of a filter size of zi. Initially, the filter size is set to xir in the 1st layer, and it is decreased by λ in each successive layer.

5. Real Time Testing: Real- time images are fed to the system and now the trained system takes decisions based on the matrix formation and CNN model. Finally the image is classified as COVID 19 or OTHER (NON-COVID, Pnemonia)

V. CONCLUSION

COVID-19 is affecting the health of the global population at an alarming rate. Testing of large numbers of individuals is crucial to curb the spread of disease. Real-time PCR is a gold standard pathological test for the diagnosis of this disease. But the increasing number of negative false reporting has led to the use of Chest X-rays as an alternative for diagnosis of COVID-19. Deep learning based recommender systems can be of great help in this scenario when the volume of patients is very high and required radiological expertise is low.

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