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CORONAVIRUS DETECTION FROM CHEST IMAGES DATASET USING MACHINE LEARNING TECHNIQUES

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ABSTRACT

COVID-19 was posed as a very infectious and deadly pneumonia type disease until recent times. Novel coronavirus or SARS-COV-2 strain is liable for COVID-19, and it's already shown the destructive nature of respiratory illness by threatening the health of many lives across the world. Clinical study reveals that a COVID-19 infected person may experience a dry cough, muscle pain, headache, fever, sore throat, and mild to moderate respiratory disease. At an equivalent time, it affects the lungs badly with the viral infection. So, the lung is often a prominent viscus to diagnose the gravity of COVID-19 disease using X-Ray and CT scan images of the chest. Despite having lengthy testing time, RT-PCR may be a proven testing methodology to detect coronavirus infection. Sometimes, it'd give false positive and false negative results than the specified rates. Therefore, to help the RT-PCR standard method for accurate clinical diagnosis, COVID-19 screening is often adopted with X-Ray or CT scan images of an individual's lung. During this project, we propose a unique system with a convolutional neural network (CNN) based multi-image augmentation technique for detecting COVID-19 in the chest using X-Ray or chest CT scan images of coronavirus suspected individuals. Thus, our proposed system provides a promising result in a short period.

Keywords: - Convolutional neural network, Interstitial Lung Disease, Tuberculosis, Chronic obstructive pulmonary disease, World Health Organization, Support vector machine.

I. INTRODUCTION

Viral lung disorders are increasing day by day throughout the planet. Respiratory diseases like Interstitial Lung Disease (ILD), tuberculosis (TB), chronic obstructive pulmonary disease (COPD), pneumonia are the most emerging health problems around the world. COVID-19 may be a recent pandemic (2019-20) everywhere within the world. Dated to 28th March 2020, around 121 million coronavirus cases and 2.67 million deaths were accounted. The first outbreak was identified in Wuhan, China, at the end of 2019 recognized as a pandemic by the World Health Organization (WHO). This virus can spread through close contact and via respiratory droplets produced when people cough or sneeze. People can also get infected from COVID-19 by touching any contaminated surface and then their face, eyes, nose, and mouth. Common symptoms like fever, cough, and shortness of breath are seen first. Complications include pneumonia and acute respiratory distress syndrome. There's no vaccine, and an outsized study has started within the field of imaging which may be wont to detect the COVID-19 by radiographs and computerized tomography. Due to overlap with other infections like adenovirus, imaging without confirmation by PCR is limited in identifying COVID-19.

II. RELATED WORK

We proposed a novel framework with a convolutional neural organization (CNN) based multi-picture enlargement procedure for distinguishing COVID-19 in the chest utilizing X-Ray or chest CT filter pictures of Covid-19 speculated people. Consequently, our proposed framework gives a promising outcome in a brief time frame. [1] They offered a framework where they utilized iteratively pruned profound learning gatherings for Coronavirus discovery in chest x-beam pictures. The joined utilization of methodology explicit information move, iterative model pruning, and outfit learning brought about improved expectations in their proposed strategy. Notwithstanding, the achievement of this methodology is constrained by two expansive components: (I) dataset size and inalienable inconsistency and (ii) computational assets required for effective organization and use. Subsequently, it is subject to these assets, and nonattendance of any of these variables can bring about erroneous or uncertain outcomes.

Then again, [2] They introduced a pictorial audit to portray the most widely recognized signs and examples of lung irregularity on chest x-ray in COVID-19 to prepare the clinical network in its endeavors to battle this pandemic. Notwithstanding, a chest x-ray is a less delicate methodology for recognizing COVID-19 lung sickness contrasted with CT, with a detailed standard chest x-ray affectability of 69%.

Convolutional Neural Network (CNN) is a Deep Learning calculation that can take in an info picture, allocate significance (learnable loads and predispositions) to different angles/objects in the image and have the option to separate one from the other. Utilizing this as the calculation [3], They investigated the Covid-19 illness.

The proposed technique misuses the learning capacity of the convolutional neural network (CNN) to characterize COVID-19 tainted versus sound patients. The proposed strategy shows excellent execution and outflanks the current methods utilizing measurements, such as precision, F-score, and ROC bend in the vast majority of the cases.

In AI, uphold vector machines are administered learning models with related learning calculations that examine information utilize for arrangement and relapse examination. That is the thing that [4] Rohith N Reddy did in his paper that he distributed in the year 2020. In this, a strategy is proposed to recognize the COVID-19 utilizing chest X-Ray pictures. To order the ordinary and COVID-19 cases, a CAD framework is created using a Support Vector Machine (SVM) Classifier with a Graphical User Interface. However, the outcomes showed a precision of 57.1% in grouping the COVID-19 pictures, which is substantially less than the different papers investigated. Another utilization of Machine Learning was utilized, which is Deep Transfer Learning. As the name proposes, learning is a methodology in deep learning (and AI) where information is moved starting with one model then onto the next.

[5,8] They distributed their paper under Medical Image and Signal Processing Research Center, Isfahan University of Medical Sciences, Iran, where they anticipated Covid-19 from Chest X-Ray pictures utilizing Deep Transfer Learning. A portion of the early investigations indicated explicit variations from the norm in the chest radiographs of patients contaminated with COVID-19. Motivated by before work, we study the use of profound learning models to identify COVID-19 patients from their chest radiography pictures. A subset of radiograms was utilized to prepare four mainstream convolutional neural organizations to distinguish COVID-19 in the investigated CXR pictures. Determining this sickness from radiography and radiology pictures is maybe probably the quickest approach to analyze the patients.

[6] They utilized a RALE score strategy to foresee Covid sickness in presumed patients. As of late, the RALE score was proposed to assess lung edema on CXR in ARDS patients. The creators utilized the RALE strategy to discover the degree of the seriousness of the infection. The RALE score can be used in this crisis setting as a quantitative strategy for the degree of SARS CoV-2 pneumonia. The RALE score was somewhat higher in male than in female patients. ANOVA with Games-Howell post hoc indicated critical contrasts of RALE scores for bunch one versus 3 ($p<0.001$) and two versus 3 ($p=0.001$). Between per user understanding in allotting RALE score was excellent (ICC: 0.92—with 95% certainty interval 0.88–0.95).

At last, the creators from Indian Institute of Technology Delhi, Indian Institute of Technology Kanpur, All India Institute of Medical Sciences Delhi, in particular, [7,9] They proposed the utilization of chest X-Ray to recognize COVID-19 contamination in the patients displaying indications of SARI. Utilizing their apparatus, one can characterize a given X-Ray in one of the four classes: typical, bacterial pneumonia, viral pneumonia, and Coronavirus pneumonia testing. The creators split the dataset for preparing purposes under four fundamental classes of pneumonia. Their methodologies utilize the pre-prepared model of CheXNet. This methodology can prompt COVID-19 recognition from X-Ray pictures with an AUROC (Area under ROC bend) of 0.9994 for the COVID-19 positive class, with a mean AUROC 0.9738.

[10] They discuss the different approaches used to detect COVID-19 and the challenges they are facing. They propose to develop an automatic detection system to prevent the transfer of the virus through contact.
For detection of pneumonia, the technique of computed tomography of the chest is also helpful. An Artificial Intelligence-based system for automatic detection of COVID-19 can be helpful in monitoring, quantifying, and distinguish contact-free personal communication. A deep learning technique is also developed to extract graphical characteristics of COVID-19 from CT images to provide a quick and precise diagnosis compared to pathogenic testing and save critical time. Using x-ray images is a bit cheap and more accessible way as compared to CT. Artificial Intelligence (AI) can provide sophisticated solutions. In the paper proposed by the authors, they concluded that Inception V3 gives an accuracy of 92%, which is relatively high compared to traditional RT-PCR testing.

[11] A vital step in combatting COVID-19 is a successful screening of contaminated patients, with one of the vital screening approaches being radiological imaging using chest radiography. This study aimed to automatically detect COVID-19 pneumonia patients using digital chest x-ray images while maximizing the accuracy in detection using deep convolutional neural networks (DCNN). The dataset consists of 864 COVID-19, 1345 viral pneumonia, and 1341 standard chest x-ray images. In this study, DCNN based model Inception V3 with transfer learning has been proposed to detect coronavirus pneumonia infected patients using chest X-ray radiographs. It gives a classification accuracy of more than 98% (training accuracy of 97% and validation accuracy of 93%). The results demonstrate that transfer learning proved to be effective, showed robust performance, and an easily deployable approach for COVID-19 detection.

To control the spread of COVID-19, many suspected cases need to be screened for proper isolation and treatment. Pathogenic research facility testing indicates the best quality level; however, it is tedious with remarkable bogus adverse outcomes. Quick and precise analytic strategies are desperately expected to battle the sickness. In light of COVID Nineteen radiographical changes in X-ray pictures, the authors meant to build a deep learning method that could extract COVID-19's

graphical features to give a clinical analysis in front of the pathogenic test, thus saving critical time for disease control. In this paper (DCNN), a machine learning classification technique is used to classify the Chest X-ray images as accuracy is the most significant factor in this issue by taking a more prominent number of pictures to train the network by increasing the number of iterations.

The proposed classification model for the detection of COVID-19 achieved more than 98% accuracy. In light of their findings, it's far believed that it will help medical doctors make decisions in scientific practice due to the high overall performance. To come across COVID-19 at an early stage, this study gives insight into how deep transfer learning methods can be used.

III. PROPOSED SYSTEM

Therefore, to assist the traditional RT-PCR methodology for accurate clinical diagnosis, COVID-19 screening can be adopted with X-Ray or CT scan images of an individual's lungs. In this project, we proposed a novel system with a convolutional neural network (CNN) based multi-image augmentation technique for detecting COVID19 in the chest using X-Ray or chest CT scan images of coronavirus suspected individuals. Thus, our proposed system provides promising results in a short period.

The proposed approach having an open-source and actively maintained tool that can find the COVID-19 virus. It uses a machine-driven design exploration to find out the architecture design ranging from initial design prototype and requirements. It takes a chest X-Ray image of a patient as an input and provides a correct diagnosis as an output. Easy deciding, thereby assisting physicians.

A. System Description

Our proposed system takes as input a chest X-Ray image, performs image processing invoking machine learning algorithms, and provides outputs with a prediction among three classes: Normal, Pneumonia and COVID-19.

- Dataset Description: The input dataset images were obtained from https://www.kaggle.com/paultimothymooney/chest-xray-pneumonia? for analysis. The dataset is publicly available for research analysis. Generally, this depository contains chest X-ray / CT images of patients with acute respiratory distress syndrome (ARDS), COVID-19, etc. At this point, there's not a massive and reliable sample available. An equivalent number of models are chosen for every class for the sake of the experimental approach.
- Pre-Processing: The pre-processing that was employed included random rotation of the images (maximum rotation angle was 30 degrees), horizontal flips, shearing, zooming, cropping, and small random noise perturbation. Image processing improves the generalization and enhances the learning capability of the model.
- Feature Extraction: In feature extraction, a new classifier will be training from scratch on top of the pre-trained model. The representations learned from the pre-trained model and whatever is treating as an arbitrary feature extractor are employed to extract meaningful features from new samples. The base convolutional network already contains generically features for classification, and there is no need for retraining the entire model. On the other hand, to increase the performance in fine-tuning weight of the top layers of the pre-trained model are "fine-tuned" along with the newly-added classifier layers. Thus, the weight was tuned from generic feature maps to features associating specifically with the provided dataset. The aim of fine-tuning is to adapt specialized features to a given task rather than overriding generic learning. Fine-tuned learning experiments are much faster and more accurate compared to a model trained from scratch.
- Convolutional Neural Network for training the model: Machine learning models require an outsize amount of knowledge to perform accurate feature extraction and classification. Regarding medical data analysis, especially if the disease is at an early stage like in COVID-19, one major drawback is that the info analyzed was relatively limited. Machine learning with the transfer learning concept is adopted to beat this limitation. The transfer learning method achieves data training with fewer samples because the retention of the knowledge extracted by a pre-trained model is then transferred to the model to train. A pre-trained model may be a previously trained network on a vast dataset, typically on a large-scale image classification task. The intuition behind this transfer learning for image classification is that if a model is skilled on a large dataset, this model will effectively serve continuously as a generic model. Through this, the model can be trained and compared.

B. Algorithm

```
inception = InceptionV3(weights="imagenet",
include_top=False,
   input_tensor=Input(shape=(224, 224, 3)))
outputs = inception.output
outputs = Flatten(name="flatten")(outputs)
outputs = Dropout(0.5)(outputs)
outputs = Dense(2, activation="softmax")(outputs)
model = Model(inputs=inception.input, outputs=outputs)

for layer in inception.layers:
   layer.trainable = False
model.compile(
      loss='categorical_crossentropy',
      optimizer='adam',
      metrics=['accuracy']
)
```

C. System Architecture

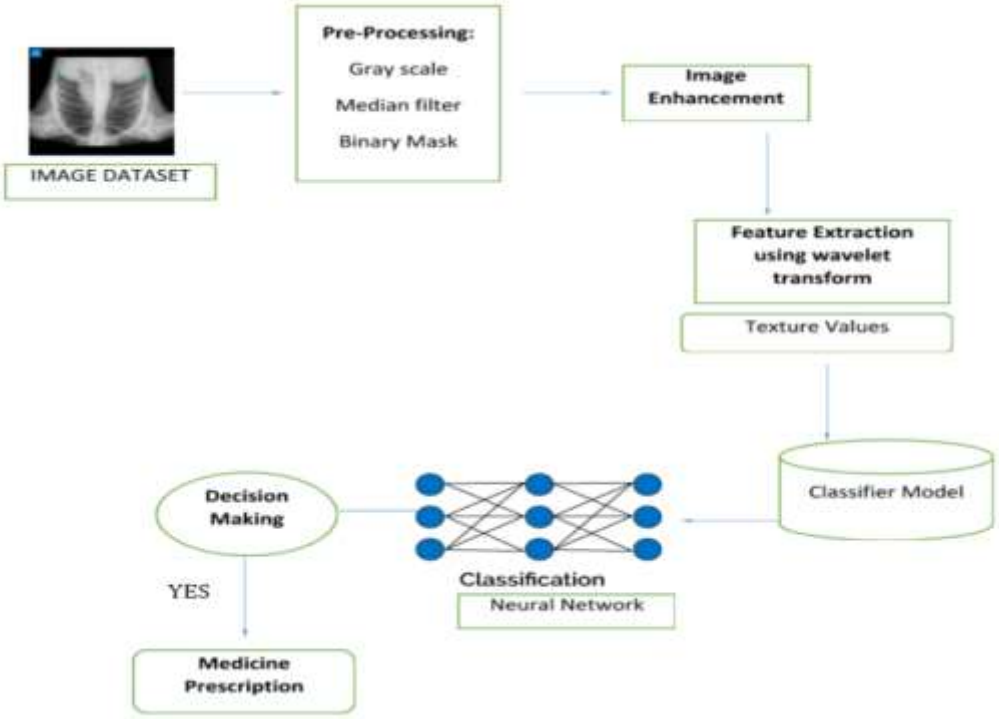

Fig. 1. System Architecture Diagram

D. Results

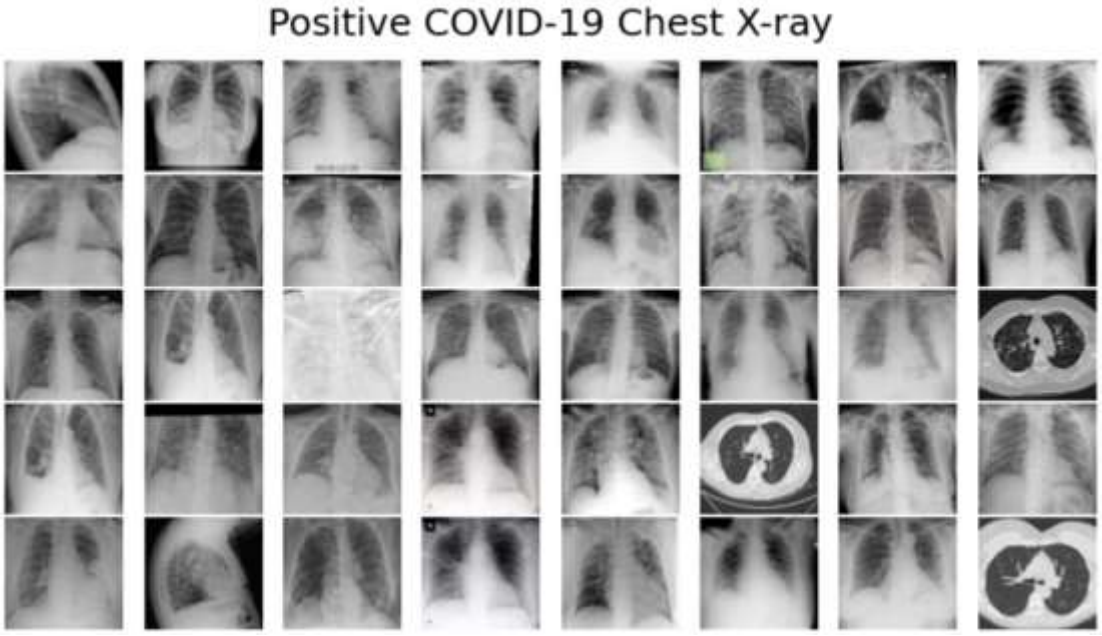

Fig. 2. 1 Positive COVID-19 Chest X-rays

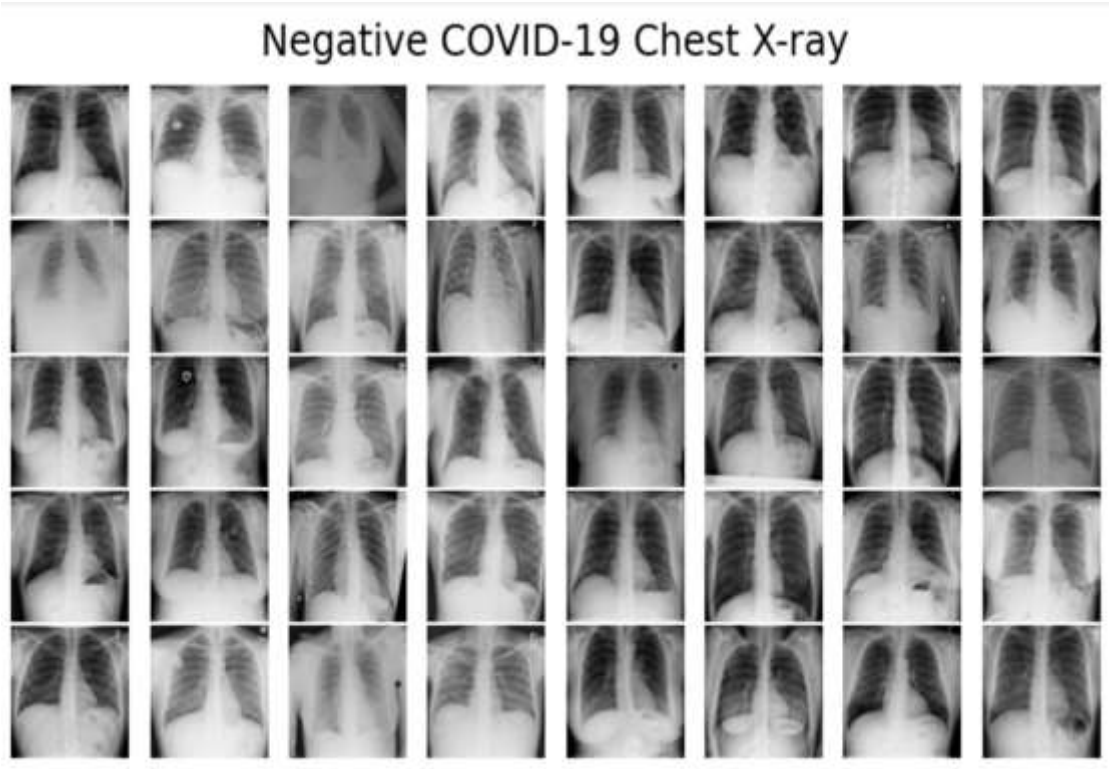

Fig. 2. 2 Negative COVID-19 Chest X-rays

E. Output

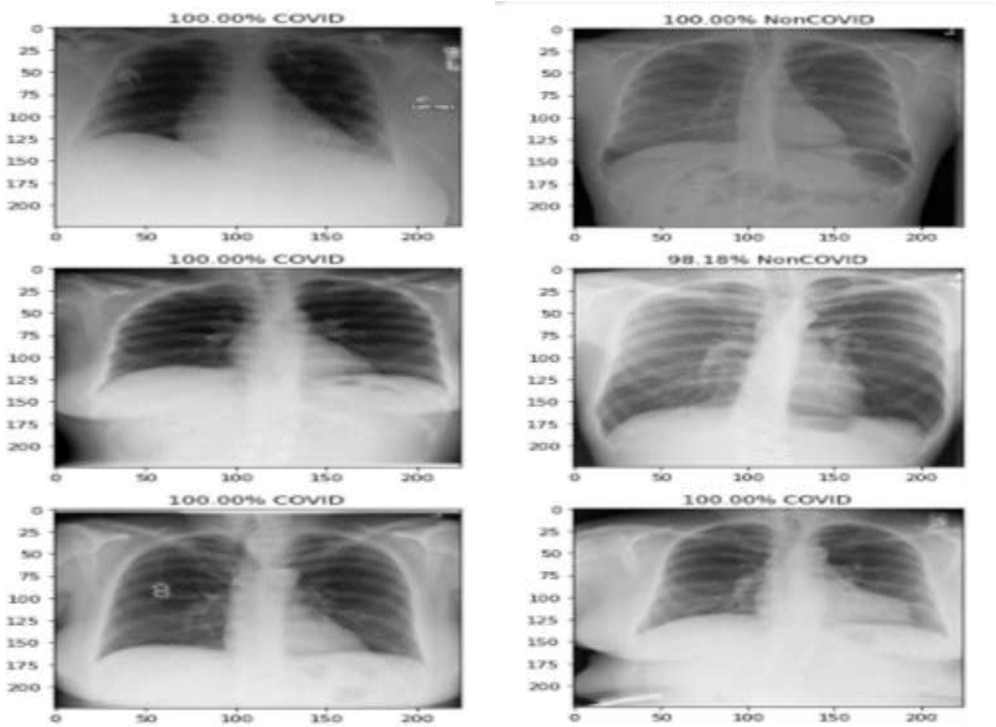

Fig. 3. 1 Covid-19 and Non-Covid-19 Detected

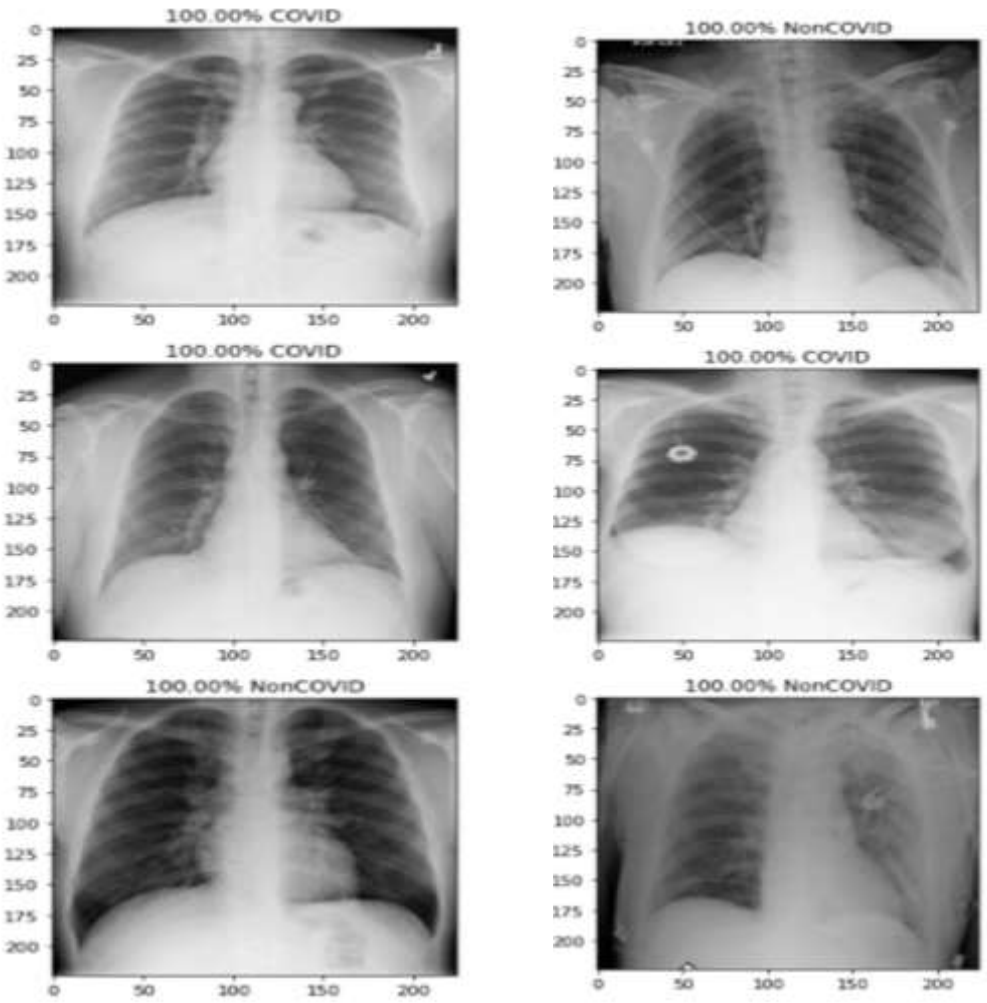

Fig. 3. 2 Covid-19 and Non-Covid-19 Detection

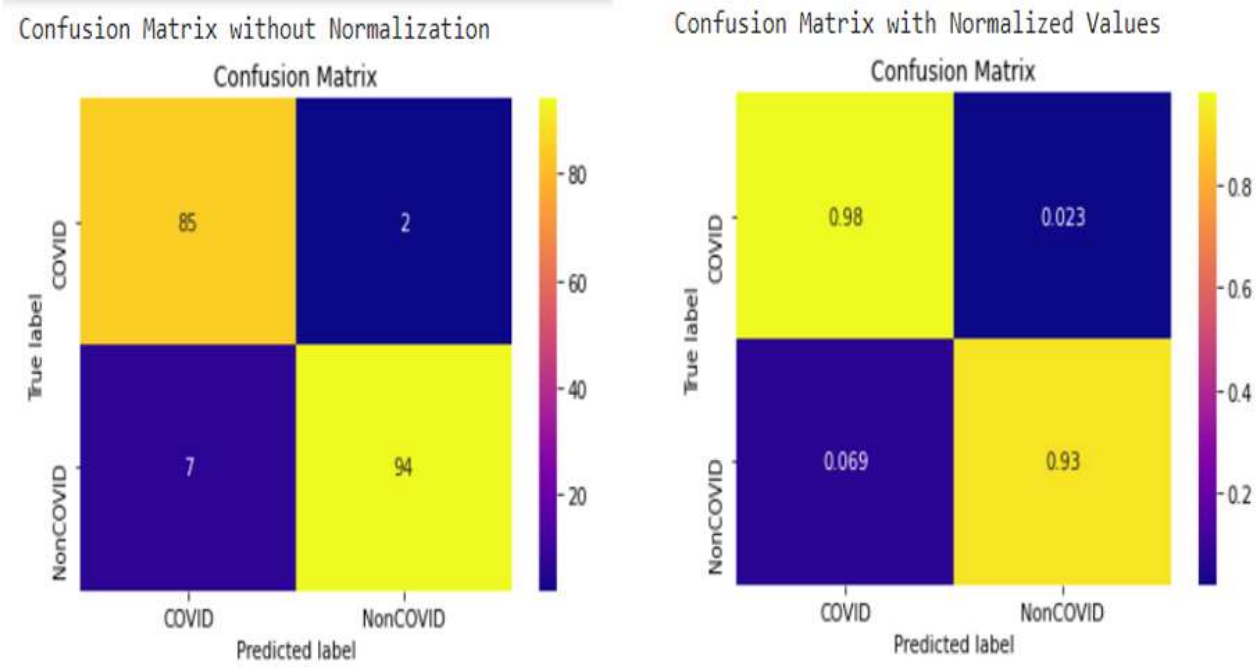

Fig 3.3 Confusion matrix without normalization and with normalization

IV. CONCLUSION

This proposed system has presented some initial results on detecting COVID-19 positive cases from chest X-Rays using machine learning techniques. We have demonstrated significant performance improvement over a publicly maintained dataset and open-source tool to classify COVID-19 positive X-rays on the same chest X-ray pneumonia dataset. The results look promising, though the amount of the publicly available dataset is limited.

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