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Diagnosis of COVID-19 Using Chest X-ray

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ABSTRACTS

Covid-19 is also a wide spreading infective agent disease that infects humans. A clinical study of COVID-19 infected patients has shown that these kinds of patients are square measure principally infected from a respiratory organ infection when come in contact with this disease. Chest xray (i.e., radiography) a less complicated imaging technique for identification respiratory organ connected issues. Deep learning is that the foremost undefeated technique of machine learning, that provides helpful analysis to review an oversize quantity of chest x-ray pictures which may critically impact on screening of Covid-19. Throughout this work, we have taken the PA read of chest x-ray scans for covid-19 affected patients conjointly as healthy patients. We have used deep learning-based CNN models and compared their performance. We have equate ResNeXt models and inspect their precision to investigate the model presentation, 6432 chest x-ray scans samples square measure collected from the Kaggle repository. This work solely core on potential ways of cluster covid-19 infected patients.

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1. INTRODUCTION

Covid-19 is a severe disease and a large number of individuals lose their lives a day. This disease affects not solely one country, but the entire world suffered as a result of this virus disease. Within the contemporary world, the entire world is full of Covid-19 disease, and also the most significant factor is not any single country scientists will prepare a vaccine for constant. In March 2020, X-ray image

of healthy folks and Covid-19 infected peoples were obtainable on-line in numerous repositories like Git hub, Kaggle for analysis (Wang Y, *et al.* 2020). Covid-19 is an epidemic disease that threatens humans at a world level and changed into an outbreak. The novel coronavirus disease came 1st as a strep throat, and suddenly folks faced issue in respiration. This infection is following a series method (Roosa K, *et al.* 2020) that transfers from one person to a different when returning in grips with covid-19 infected persons. Hospital workers, nurses, doctors, and clinical facilities play a vital role within the designation of this epidemic. A lot of technique area unit applied to cut back the result of coronavirus. Medical imaging is additionally a way of analyzing and predicting the consequences of covid-19 on the anatomy. In this, healthy folks and Covid-19 infected patients are often analyzed in parallel with the assistance of chest X-ray image. For contributing to an analysis of Covid-19, we have a tendency to collected uploaded knowledge of X-ray image of healthy and covid-19 infected patients from totally different sources and applied 3 different models (InceptionV3, Xception, and ResNeXt) (Kanne JP, 2020). The analysis of this collected knowledge is finished with the assistance of CNN, a machine learning tool. This work mainly focuses on the utilization of CNN models for classifying chest X-ray images for coronavirus infected patients. we have tried to draw a parallel to the previous add the sector and appearance for potential models of the task, which may be assessed additional to prove their quality in sensible eventualities. Deep learning based mostly models (and a lot of specifically Convolutional neural networks (CNN)) are shown to exceed the classical AI approaches in most of system vision and and medical image analysis tasks in recent years.

This paper, additional classified within the completely different sections. mentioned numerous researchers' views in analyzing the impact of the covid-19 disease on countries and humans. Dataset used and model formulation, completely different matrices and algorithms used. Further, the analysis of leads to terms of training and testing with confusion matrices for models used Next.

2. LITERATURE REVIEW

Following are a few literature reviews papers we discovered and read. These papers contain similar implementations and ideas whereas they have some or the other limitations. We received the following papers in order to come to a few conclusions as well as define their limitations when compared to our approach:

- **Afshar P, Heidarian S, Naderkhani F, Oikonomou A, Plataniotis KN, Mohammadi,** The authors projected a framework model supported Capsule Networks to diagnose Covid-19 (i.e., COVID-CAAPS) illness with the assistance of X-ray pictures. during this projected work, many convolution layers and capsules square measure wont to overcome the matter of class-imbalance. In experimental analysis, As a result, they ended that the projected model shows accuracy 95.7%, whereas sensitivity is shown as 90% and specificity as 95.80% whereas put in a smaller sort of trainable parameters (Afshar P, *et al.* 2020).
- **Alqudah AM, Qazan S, Alqudah**, The author planned a hybrid system supported computing, that specially used

machine learning and deep learning algorithms (i.e., Convolutional Neural Network (CNN) apply softmax classifier). The planned system is specially enforced for police investigation Covid-19 cases apply chest X-ray pictures (Alqudah AM, *et al*. 2020).

- **Hassanien AE, Mahdy LN, Ezzat KA, Elmousalami HH, Ella**, The authors counselled a deep primarily based methodology (with vector device classifier) for the detection of patients infected from Covid-19 by apply X-ray pictures. This technique is useful to hospital doctors for early sleuthing the cases of covid-19 infected patients. They realize 97.48% accuracy of the planned model for respiratory organ classification with the assistance of various matrices parameters (Hassanien AE, *et al*. 2020).

- **Ilyas M, Rehman H, Nait-ali**, The authors mentioned the various methodologies used for covid-19 illness detection and challenges sweet-faced. They additionally aforementioned that Associate in Nursing automatic methodology for detective work the Covid-19 virus ought to be developing to forestall the spreading of the disease through contact. Then, they analysed completely different chest X-rays for the detection of respiratory disorder and terminated that it's laborious to predict that Covid-19 causes respiratory disorder or the other symptom's area unit liable for this (Ilyas M, *et al*. 2020).

- **Ozturk T, Talo M, Yildirim EA, Baloglu UB, Yildirim O, Acharya UR**, The authors projected a model that mechanically detects the Covid-19 with the assistance of Chest X-ray pictures. The planned model is employed to convey correct medicine on 2 completely different classification models (i.e., binary and multi-class). They apply the DarkNet model to classify the period of time object detection method (Ozkaya U, *et al*. 2020).

3. PROPOSED SYSTEM OVERVIEW

The given model shows that how the proposed system will work, all the steps we take to implement it and use it to predict the data based on the performance of it (see Fig. 1).

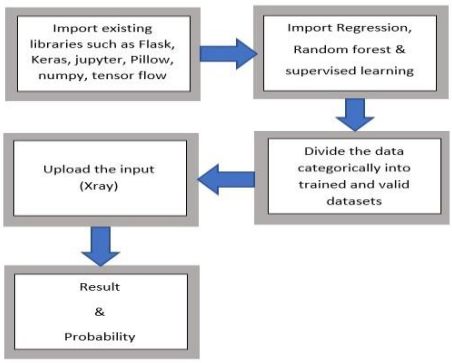

Fig. 1. Steps Implementation System

4. FEATURE EXTRACTION

4.1. Methodology

1. Dataset

The source where we have collected the dataset was the Kaggle repository, which contains Chest X-Ray scans of Covid-19 affected, normal. The collected dataset have 6432 total chest X-ray images. This data set is further divided into training (i.e., 5467) and validation (i.e., 965) set of normal, covid, and pneumonia. In the training set, 1345 is normal, 490 are covid, and 3632 is pneumonia. In the validation phase, 238 samples of a normal case, 86 covid, and 641 of pneumonia were considered for this analysis, were considered for this analysis. The scans were scaled down (Table 1).

Table 1. displays the data distribution for training and testing the data

	Train	Tests
Healthy Person	1345	238
Covid-19 Infected Patient	490	86
Pneumonia Infected Patient	3632	641

128 × 128 to assist the quick coaching of our model.

2. Model formulation

The dataset to stop over-fitting. The augmentations enclosed rotation, zoom, and sharing of pictures. The information was then shuffled to generalize the model and cut back over-fitting. After this, the ready dataset was wont to train the projected model (Wang S, *et al*. 2020). For higher analysis, 3 completely different models are enforced, and so their performance was compared to calculate the accuracy. within the given models, we have a tendency to enforced LeakyReLU activation rather than the originally used relu activation operate, which makes it as a unique technique. This method helps to hurry up the training and conjointly avoids the matter of dead neurons (i.e., the relu neurons become inactive because of zero slopes). Figure one shows the projected model for chest x-ray image analysis (see Fig. 2).

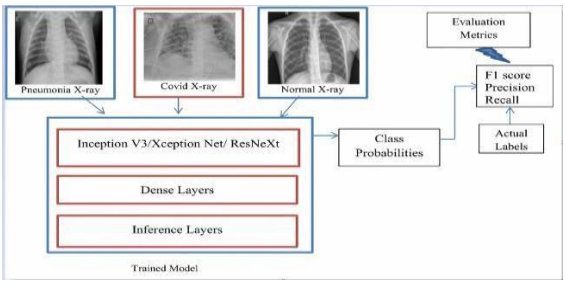

Fig. 2. The architecture of CNN model

3. Inception net V3

Inception internet V3 may be a CNN based mostly network for classification. It's forty-eight layers deep and uses beginning modules, that includes of a concatenated layer with 1 × 1 3 × 3 and 5 × 5 convolutions. By doing this, we will decrease the number of parameters and increase the coaching speed. It's additionally noted as Google Net design.

4. XCeption net

It is a modification of the origination internet. during this model, the origination modules square measure replaced with depth wise divisible convolutions. Its parameter size is analogous to the origination internet (Chollet F, 2017). However, it performs slightly higher as compared to the origination internet.

5. ResNeXt

RESNeXt is an associate degree extension design of the deep residual network. during this model, the quality remaining blocks square measure replaced with one that leverages a split - remodel - merge strategy employed in the Inception models.

4.2. Algorithm

Step 1:Preprocess image i.e. image = X

Preprocess apply (We have utilized Keras data generator for this goal)

1. Reshape image (X) to (128, 128, 3)

2. Random rotation range is 10°

3. Horizontal Flip is True

4. Zoom Range is 0.4

Step 2: Applying the picture to firstly input of the pre-trained model Step 3: Get

the output of the last convolution layer of the given model.

Step 4: Flatten size with reducing n size to n-1.

Step 5: Put a dense layer units is equal 256 for Inception Net and Xception Net units is equal 128 for ResNeXt

$$Z=W\ (A+bZ)=W\ (A+b)$$

Step 6: Apply

$$A=\text{LeakyReLU}(Z)A=\text{LeakyReLU}(Z)$$

Step 7: Apply Dense Layer for abstract thought

$$Z=W\ (A+bZ)=W\ (A+b)$$

Step 8: Apply softmax for classification

Soft ∑

Thi proposed model has been evaluated with the help of different parameters such as precision, recall, F1 score, its accuracy, sensitivity, and specificity as shown in Equation below.

$$\text{Precision} = \frac{True\ PositiveTrue}{True\ Positive+False\ PositivePrecision}$$

Recall (or Sensitivity) = ——————————

F1 Score = 2 * ——————

Accuracy = ——————————————————————

Specificity = ——————————

Xception net:

It is a modification of the origin internet. during this model, the origin modules area unit replaced with depth wise dissociable convolutions. Its parameter size is comparable to the origin internet, however it performs slightly higher as compared to the origin internet (Tables 2 and 3).

5. EXPERIMENTAL RESULT

5.1. Matrices used for result evaluation

Table 2. f1-score for Training Dataset for XCeption Net Model

Label	Precision	Recall	f1-score
Normal	1.00	0.99	1.00
Covid-19	1.00	1.00	1.00
Pneumonia	1.00	1.00	1.00
Accuracy			1.00

Table 3. f1-score for Testing Dataset for XCeption Net Model

Label	Precision	Recall	f1-score
Normal	0.98	0.93	0.95
Covid-19	0.99	0.92	0.95
Pneumonia	0.97	0.99	0.98
Accuracy			0.97

(a) Confusion matrix of train data of Xception model. (b) Confusion matrix of test data of the Xception model (see Fig. 3)

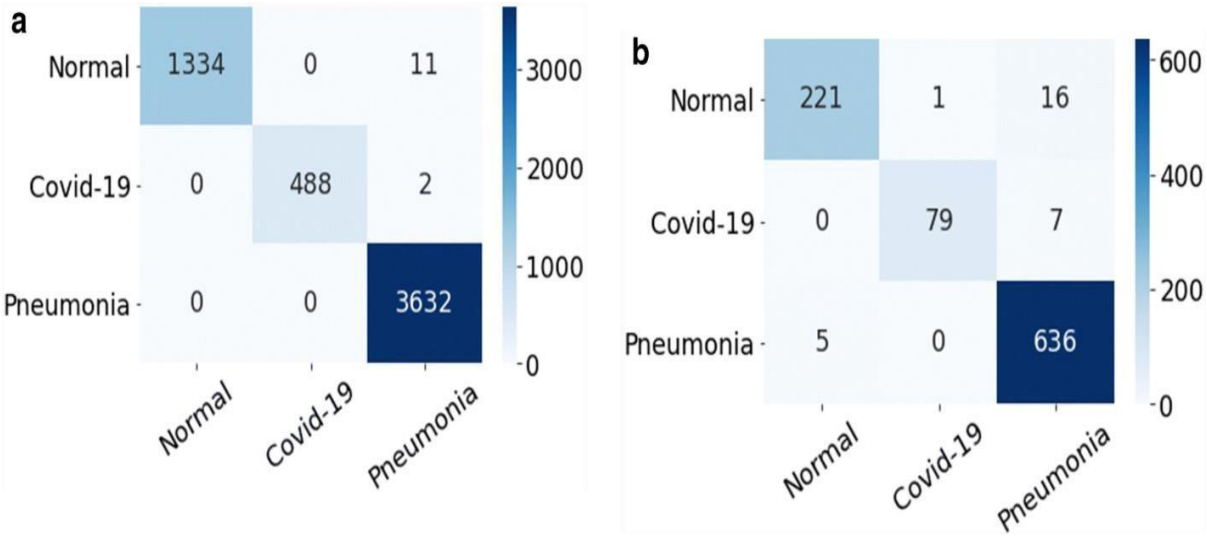

Fig. 3. Training and Testing data of the Xception model shows the confusion matrix.

Inception net V3:

It is a state of the art Convlution Neural Network for classification. it's 48 layers deep and uses beginning modules, that contains a concatenated layer with 1 × 1 3 × 3 and 5 × 5 convulsions. Doing this, we are able to decrease the quantity of parameters and increase the training speed. it's conjointly named as Google Net design (Tables 4 and 5).

Table 4. Depict the f1-score on Training Dataset for the Inception V3 model.

Label	Precision	Recall	f1-score
Normal	1.00	0.97	0.99
Covid-19	1.00	1.00	1.00
Pneumonia	0.99	1.00	1.00
Accuracy			0.99

Table 5. Depict the f1-score on Testing Dataset for the Inception V3 model.

Label	Precision	Recall	f1-score
Normal	0.98	0.87	0.92
Covid-19	0.96	0.95	0.96
Pneumonia	0.95	0.99	0.97
Accuracy			0.96

ResNeXt:

This design is to Associate in Nursing extension of the deep residual network. during this model, the quality of remaining blocks area unit replaced with one that leverages a split - rework - merge strategy utilized in the Inception models (Tables 6 and 7).

(**a**): Confusion matrix of train data of Inception V3, (b) Confusion matrix of test data of Inception V3 (see Fig. 4)

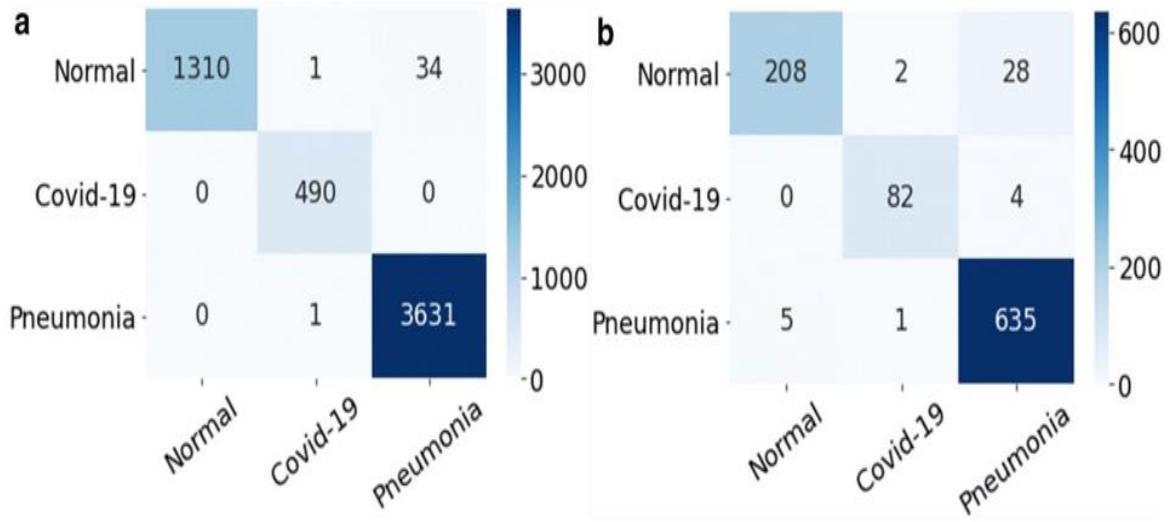

Fig. 4. Training and Testing data of Inception V3 model shows the confusion matrix.

Table 6. f1-scores for the Training Dataset for ResNeXt Model

Label	Precision	Recall	f1-score
Normal	0.99	0.98	0.98
Covid-19	1.00	0.90	0.95
Pneumonia	0.98	1.00	0.99
Accuracy			0.98

Table 7. f1-scores for the Testing Dataset for ResNeXt Model

Label	Precision	Recall	f1-score
Normal	0.91	0.89	0.90
Covid-19	0.97	0.78	0.86
Pneumoina	0.94	0.97	0.95
Accuracy			0.93

(a). Confusion matrix of train data of ResNeXt model. (b): Confusion matrix of test data of ResNeXt model (see Fig. 5).

In the analysis of result, typical chest X-ray pictures are compared with Covid-19 affected people. Inception Net V3,

Xception Net and Res NeXt are analysed supported accuracy matrices. The results were then contrasted to work out the simplest model. Although the model predictions are very high, we suggest validating the execution using future updates on the dataset. because of the limited amount of information, the model is trained only on 1560 samples (see Figs. 6 and 7).

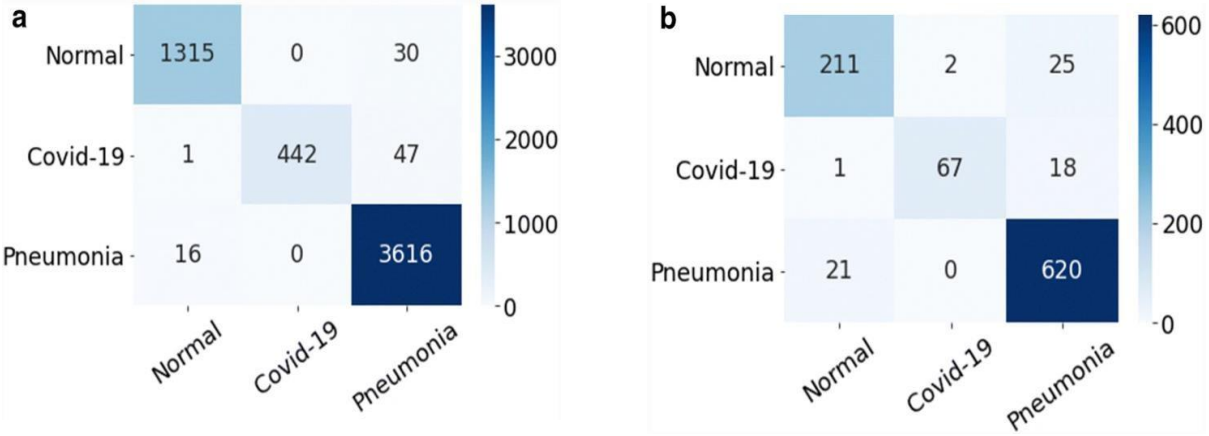

Fig. 5. Training & Testing data of the ResNeXt Model shows the confusion matrix.

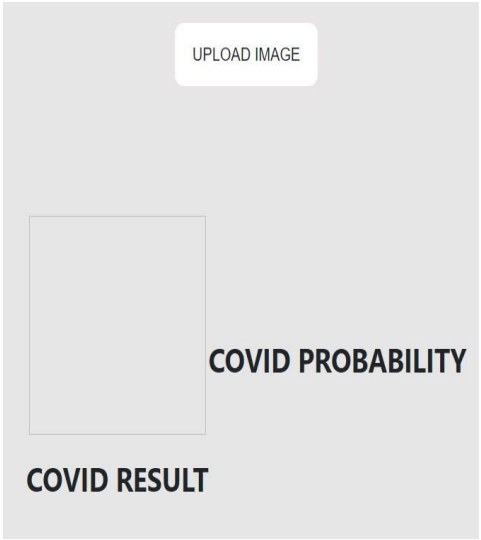

Fig. 6. Mockup Upload Image

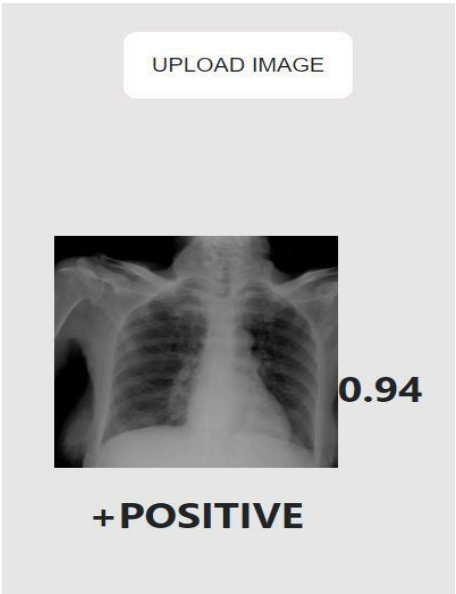

Fig. 7. Mockup Results

6. ADVANTAGES

The following advantages of the implemented method or system are mentioned below:

1. The cost of Detecting COVID19 using chest x-ray is low as compare to RTPCR Kit.

2. Through RTPCR Kit it takes 24 hours for the result but if we started the test through chest x-ray it takes less time.

7. CONCLUSION

A covid-19 pandemic is also growing very fast. With the ever-increasing range of cases, bulk testing of cases fleetly might even be needed. Throughout this work, we have a tendency to experimented with multiple CNN models in an attempt to classify the Covid-19 affected patients mistreatment their chest X-ray scans. Further, we have a tendency to over that out of these 3 models, the XCeption web has the best performance and is suited to be used. We have with success classified covid-19 scans and it describes the likely range of applying like procedure within the close future to automate analysis tasks. The high accuracy obtained could also be an

explanation for concern since it's going to be a result of overfitting. This will be verified by testing it against new data that's made public shortly. within the future, the big dataset for chest X-rays is often considered to validate our proposed model thereon. it's also advised to consult medical professionals for any practical use case of this project. We develop a perfect detection mechanism however solely analysis concerning attainable economically possible ways in which to fight this unwellness. Such strategies might even be pursued for additional analysis to prove their real case implementation.

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