ISSN:2731-538X | E-ISSN:2731-5398
Vol. 18 No. 01 (2024)

USING PRE-TRAINED CONVOLUTIONAL NEURAL NETWORKS, AN ANALYSIS OF COVID-19 AND PNEUMOMIA

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ABSTRACT

Global crises brought the new corona virus illness outburst that started in December 2019. As of October 10, 2020, more than 200 nations have been affected by the pandemic, which has resulted in approximately 37 million confirmed infections and over a million deaths..The necessity for establishing a quick, inexpensive, and accurate screening approach is increasing as the number of cases rises. For this, Kaggle is used to collect the chest x-ray images. Inception-v3, Resnet50, two convolutional neural network architectures, are employed as feature extractors in this work. Then, the derived features are given to Random Forest. Random Forest classifies into COVID 19, Pneunomia and normal image. The features obtained from Inceptionv3 with Random Forest provides the satisfactory results of 91.11%.

Keywords: Chest X-rays (CXR), Inception-v3, Resnet50, Random Forest, Computed Tomography (CT)

INTRODUCTION

The World Health Organization states that pneumonia and COVID-19 are the two main illnesses that kill more people worldwide. 450 million individuals are impacted, approximately. Approximately 657 cases out of 1000 children are affected by this as well. Different forms of pneumonia can be identified using CBC, CT scans, and CXR. Another shape of pneumonia caused by a coronavirus-2 is Covid-19. There have been 284,941,067 cases documented as of December 2021. Of these, 26,899,274 are currently awaiting a diagnosis, 252,602,844 have recovered, and 5,438,949 have passed away [1]. Fig 1. Implies the COVID 19 chest x-ray image, of normal and pneunomia images.

Fig 1. COVID 19

Fig 2. Normal Image

Fig 3. Pneunomia Image

A person may have a random or antigen test, also known as a serology or blood test, or a molecular test, commonly referred to as the "golden test" for Covid-19 (RT-PCR test) in order to detect the virus. These examinations could take longer than normal. Thus, with a doctor's assistance, chest radiology procedures such as CT scans and X-rays are employed to obtain speedier findings [2][3]. The symptoms of both diseases are similar and include fatigue, fever, coughing, shortness of breath, and sneezing.

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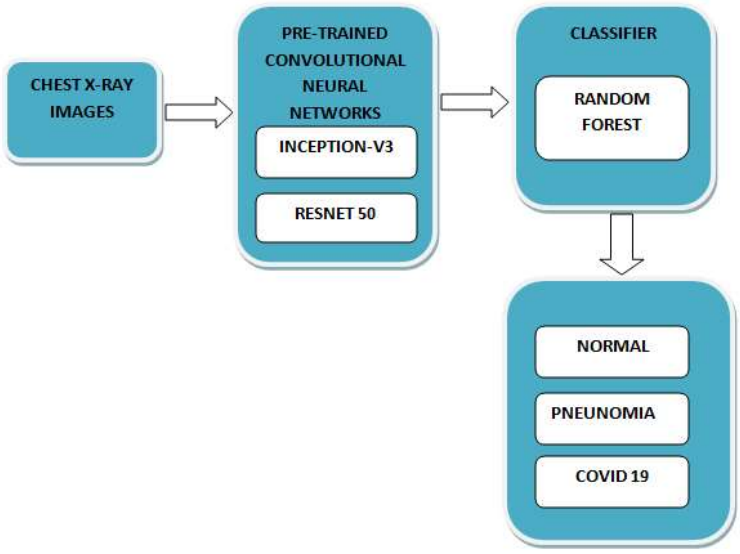

Fig 2. Shows the Overall Framework of proposed block diagram

LITERATURE SURVEY

This study [4] advocates using chest X-ray radiographs to identify patients with coronavirus pneumonia using five models based on convolutional neural networks that have been trained beforehand. The pre-trained according to the performance findings.Using the CapsNet neural network and pre-trained CNN (VGG16) was proposed in this research [5]. The model uses SMOTE and the augmentation procedure to deal with the inequality and small data size. The hyperparameters of the Capsule neural networks have been fine-tuned using the Gaussian optimization method in four different scenarios. The results show that when used in conjunction with related work, the pre-trained with optimized CapsNet performs better than the other scenarios used. In comparison to analogous models, the CapsNet model gives the highest accuracy rate of 96.58% .

This paper computationally experiments with three different datasets to determine the general CNN-based model that can provide the best classification accuracy, sensitivity, and specificity on respiratory diseases from CXR images. The models that demonstrate the greatest potential for improvement are VGG16, DenseNet121, InceptionV3, Xception, and InceptionResnetV2. In the interim, dataset 3 is produced using the COVID-QU-Ex dataset. Trained CNN models can achieve cutting-edge performance by modifying the basic models' convolutional layer parameters and then feeding in the high-level feature.

PRE-TRAINED CONVOLUTIONAL NEURAL NETWORKS

INCEPTION-V3

Convolution layer factorization by the Inception-v3 model could reduce the number of parameters without compromising accuracy [6]. Once more, it concatenated the convolutional layer and max-pooling, increasing the effectiveness of feature reduction. One of the model's advantages was its ability to retrieve output from any given concatenation node [7]. There are a total of 11 mixed layers, which go by the name of mixed layer.

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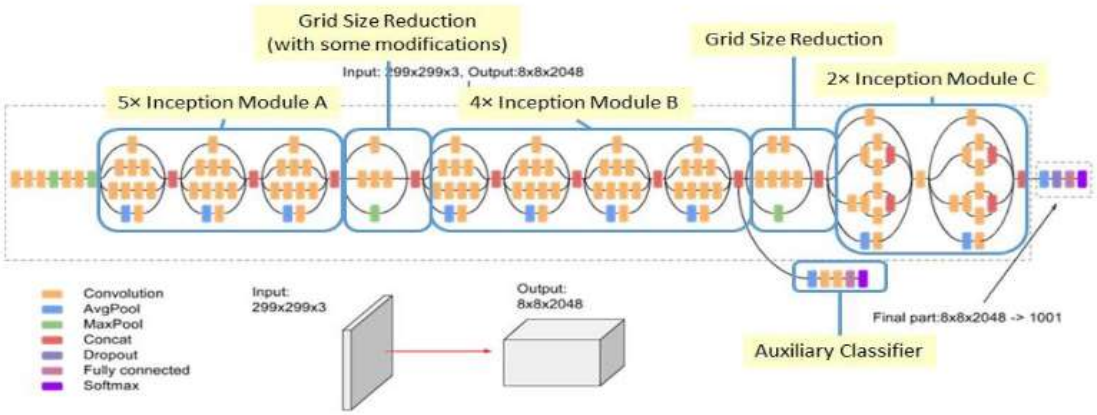

Fig 3 Block Diagram of Inception v3

Resnet50

The image has an input size of 224 x 224 x 3. Each ResNet structure uses different 7 x 7 and 3 x 3 kernel sizes for the first convolution and max pooling.. The network's initial phase then starts, consisting of three residual blocks that each have three layers. The kernel sizes that are used for the convolution operation with the first stage's three levels of the block are 64, 64, and 128 in that order. The winding point to the perceptive relationship[8]. It shows stride 2 is used for the contortion process in the Residual block. Consequently, the input's height and breadth will be halved, but the channel width won't change. Constriction patterns are used for large networks such as Resnet 50, Resnet 152, etc. Three layers are drifted one over the other for each surplus process F [9]. Three levels of convolution are 1x1, 3x3, and 1x1. The dimensions are decreased and then replaced by the 1x1 convolution layers. It is comprised of 1000 neurons, is the final layer [10].

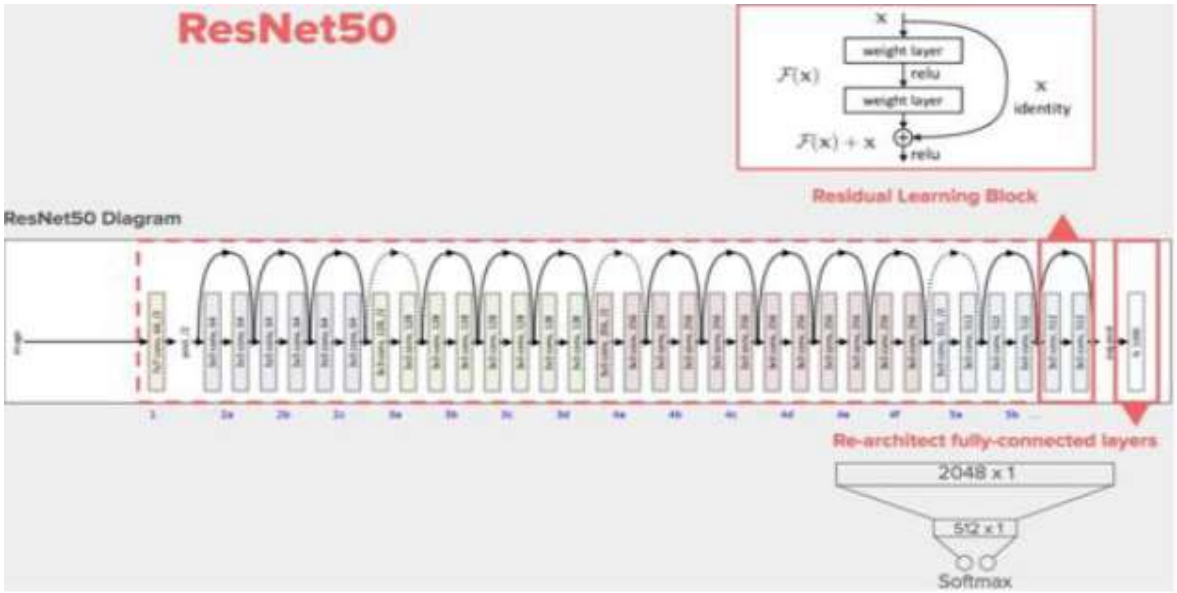

Fig 4. Block Diagram of Resnet50

MODELLING THE FEATURES FOR COVID 19 AND PNEUNOMIA

RANDOM FOREST

ISSN:2731-538X | E-ISSN:2731-5398
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A forest, or set of tree predictors, is what RF refers to. Regression and classification problems are the primary uses of the RF classifier [11].

• Using the test features, apply the control of each decision tree that is arbitrarily created to anticipate the output and record the desired outcome.
• Find out who voted for each anticipated goal.
• Take the target with the highest vote total as the RF model's final prediction.
• The trained RF model renders the test features according to each randomly generated tree's rules in order to perform the classification procedure.

PERFORMANCE MEASURES

Precision, Recall F-Score, and Accuracy are used by Random Forest to validate the performance of Inception v3 and Resnet50.

EXPERIMENTAL RESULTS

DATASETS

From Kaggle datasets, a sum of 251 x-ray pictures gathered, with 80% of the photos being utilized for training and 20% for testing. There are 111 COVID, 70 normal, and 70 pneumonia pictures.

Inceptionv3 Pre-Trained as Feature Extractor

The output layer is the softmax prediction on 1000 classes, and the input layer measures 299 x 299 x 3. Maximum pooling by 8x8x2048, also known as feature extraction in the model, comes after input layer and is considered to be the model's classification, with the remaining network layers falling between. Since the features in this study are extracted using Inception-v3, each individual image has a 2048 feature vector.

Pre-Trained Resnet 50 as Feature Extractor

The softmax prediction on 1000 classes makes up output layer, whereas input layer uses with dimensions of 224 × 224 x 3. Maximum pooling by 7x7x2048, spanning from the input layer to the completion, is thought to represent model's feature extraction, while the remaining portion of the network is shown as the model's classification. This study uses Inception-v3 for feature extraction, resulting in a 2048 feature vector per image.

Classification with Inception v3 and Random Forest

CHEST X-RAY IMAGES	PRECISION	RECALL	F-SCORE	ACCURACY
NORMAL	93.10	90.11	89.50	91.11
PNEUNOMIA	91.11	88.67	90.53	90.34
COVID 19	90.65	87.76	83.11	89.67

Classification using Random Forest with Resnet50

CHEST X-RAY IMAGES	PRECISION	RECALL	F-SCORE	ACCURACY
NORMAL	89.12	87.66	88.65	89.88
PNEUNOMIA	85.45	86.66	87.45	88.59
COVID 19	87.56	85.98	88.45	90.55

CONCLUSION

Given as the input to Random Forest in the proposed work, Inceptionv3 yields the highest

ISSN:2731-538X | E-ISSN:2731-5398
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accuracy of 91.11% when compared to Resnet50 and Inceptionv3.

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