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Covid-19 Detection From X-ray Images Using Deep Learning

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Abstract: Covid-19 has caused major outbreak worldwide and it keeps on catastrophically affecting the wellbeing and life of many people globally. Coronavirus is an RNA which, due to its mutation features, is very difficult to diagnose and treat. Fever, cough and shortness of breath, dizziness, headache, and muscle aches are the highly common symptoms of Coronavirus. The virus is so dangerous and can cause people with compromised immune systems to die. As number of confirmed cases and death increasing rapidly across the world, need for a diagnostic system to detect the disease is increasing. Currently RT-PCR technique is used to diagnose Coronavirus. It is less-sensitive, costly and requires professional medical person. Most of the Scientific studies have proved that Coronavirus victims go through chest infection i.e., having problem in breathing which can be easily detected using image classification techniques. CT scan are considered more effective for the diagnosis of lung related disease but X-rays are widely available due to its low cost and faster results. The aim of this paper is to produce a reliable, precise and affordable diagnostic system which uses X-rays images to detect Covid-19 by applying deep learning approach. So, in this paper, we going to use transfer learning from DL is used to diagnosis Coronavirus. Transfer learning is the technique in which pre-trained models on one task is used to solve another task. Our intention is to minimize the risk of quarantine patients getting infected while waiting for their results to come out and provide some relief to exhausted medical professionals with an alternate and safe method through intelligent deep learning image classification models. This will be beneficial especially for rural areas where covid19 check-up doctors aren't easily available.

Index Terms **- Transfer learning, Deep Learning, Covid-19, X-Ray, Quarantine.**

I. INTRODUCTION

In the end of 2019, the novel COVID-19 infection became known in China (Wuhan), where it rose up out of control and it spread rapidly worldwide via air and actual touch, for example, the best way of transmitting COVID-19 is hand contact with an infected individual, via the respiratory system, the infection embeds itself into the lung cells and imitates there, slaughtering these cells. Coronavirus is an RNA which, due to its mutation features, is very difficult to diagnose and treat. Fever, cough and shortness of breath, dizziness, headache, and muscle aches are the highly common symptoms of Coronavirus. The virus is so dangerous and can cause people with compromised immune systems to die. Specialists in infectious diseases and clinicians worldwide are trying to find a cure for the disease. For thousands of nations worldwide, Coronavirus is still the major cause of death including USA, India, Russia, China etc. In its early stages, COVID-19 detection is crucially essential and critical. Both diagnosis of corona disease has to be checked by RT-PCR, according to WHO.

RT-PCR testing, nonetheless, is very tedious, and its result is very risky for individuals with COVID-19. In this manner, for the essential distinguishing proof of COVID-19, clinical imaging is first led, at that point the RT-PCR test is performed to help specialists in the last exact identification. For the detection of Coronavirus, we have used image classification algorithm, X-ray. The principal strategy to analyse COVID19 is the X-ray methodology, which has the advantage of being affordable and low-risk for human wellbeing from radiation risks. Identifying COVID-19 is a generally difficult in the X-ray process. The radiologist must note that the white spots containing water and pus in these photos, which are very prolonged and troublesome. COVID-19, can also be wrongly identified by a radiologist or specialist doctor because Other illnesses, such as pulmonary tuberculosis or any other such disease. There is a high error rate in the X-ray system; CT pictures can accordingly be utilized for more dependable recognition. In any case, these CT-scan are significantly costlier than patient X-ray. A few cuts of every individual associated with COVID-19 are given at the hour of the CT-scan recording. In order to diagnose Coronavirus, the colossal number of X-ray pictures requires a high outstanding burden on doctors and radiologists. Uses of artificial intelligence in medication have driven in recent years to a number of studies aimed at diagnosing a variety of diseases, including MR image brain tumour, various forms of brain disorders for example EEG, mammographic picture breast cancer and pneumonic infections to identified that mostly used in medical are X-Ray of Covid-19 and CT-Scan of Covid-19. Throughout the most recent decade, in many applications of artificial intelligence in data processing, Deep Learning (DL) is a part of AI that has changed standards by achieving human-level precision in many tasks, including medical image analysis.

1.1 DL Algorithm for Coronavirus Detection

The two critical branches of AI are traditional ML and DL, but DL is basically a more sophisticated variant of traditional ML. Different DL networks have been used widely to predict Coronavirus using different freely available databases.

II. COMPUTER AIDED DIAGNOSIS SYSTEM (CADS) FOR CORONAVIRUS DETECTION

Using CT images and X-ray, several CADS have been evolved using DL methods. Two types of technology have been evolved i.e. (i) classification (ii) segmentation using DL methods. The main agenda is to define Coronavirus patients in classification-based CADS, which includes the process of classifying, selecting-features, extracting-features using deep layers. CADs is used for the segmentation of X-ray and CT-Scan images of each people with Coronavirus, the second form, CAD, is. Segmentation means the separation of images into meaningful fields and is of particular significance in medicine. It takes a lot of time to manually segment medical images, so it is critically necessary to apply machine learning models. With the segmentation method, the CT-Scan images of patients and their physical division diagnosed by doctors are given to the DL network in the CADS. Then, the DL network is trained on physical division to segment raw input images during the training process. Lastly, segmented images are provided with segmentation accuracy in deep network performance. Various databases (X-ray and CT images) available for Coronavirus diagnosis and prediction also displays the databases used to forecast corona spread in the world's leading countries.

III. ALGORITHMS

In this section, various DL methods proposed for the diagnosis of coronavirus are discussed. For the identification of coronavirus patients using X-rays. VGG16, VGG19, Inceptionv3 and ResNet50 were used.

3.1 InceptionV3

Inceptionv3 is an Inception family convolutionary neural network structure. In Inception v3 it provides multiple improvements, as well as the use of Factorized (7 × 7) convolutions, Label Smoothing and the use of an auxiliary classifier to relay label data across the network. Inceptionv3 focuses primarily on burning less computational resources by changing previous Inception architectures. Inception Networks have proven to be more computer-efficient compared to VGGNet, both in terms of computational performance.

3.2 VGG16

A few convolutionary layers compose the VGG architecture, each of which uses the activation function of the ReLU. The size is equivalent to 3x3 for convolutional layers, with a phase of 2 in VGG-16, and VGG-19 are three versions of the model that correspondingly have 16, and 19 layers. Both VGG architecture variants end with three layers of FC. However, the number of convolution layers is different; there are 16 convolution layers in VGG-19, 13 convolution layers in VGG-16.

3.3 VGG19

A few convolutionary layers compose the VGG architecture, each of which uses the activation function of the ReLU. The size is equivalent to 3x3 for convolutional layers, with a phase of 2 in VGG-16, and VGG-19 are three versions of the model that correspondingly have 16, and 19 layers. Both VGG architecture variants end with three layers of FC. However, the number of convolution layers is different; there are 16 convolution layers in VGG-19, 13 convolution layers in VGG-16.

3.4 ResNet50

With different numbers of layers, the residual network (ResNet) is created. One of the common variants with convolution layers which is 49 and one FC layer at the end of it is ResNet50. A Convulsions Matrix of ResNet50 used for Coronavirus diagnosis.

IV. DATASET

Pictures of Chest X-ray from Kaggle that is famous database named as Kaggle chest X-ray database with has chest X-ray pictures (5247) which consists of regular, bacterial pneumonia, viral pneumonia ranging in quality from 400 pixel to 2000 pixel. 3906 pictures from various subjects infected by pneumonia which consists of viral pneumonia (1345 pictures) and bacterial pneumonia (2561 pictures) come from 5247 chest X-ray database. We have used GitHub IEEE8023 database for Covid-19 images which is also a very popular database for X-ray images and it keeps getting updated every day for better accuracy and precision.

V. PROPOSED SYSTEM

This segment gives us the idea about the logic of the proposed CNN which is used to become aware of COVID-19 instances and outlines Proposed convolution neural network implementation. The thought includes model that offer a simple CNN structure and a transfer learning algorithm of set of rules. CNN algorithms working by extracting of some features through a sequence of layers that is convolution layer which is accompanied by completely linked layers of neural. We have numerous sorts of Transfer learning algorithms which begins with convolution neural network and ends with recurrent Neural networks. The convolution neural network may be implemented on those results when the data are obtained all through a domain that is spatial domain which include image of applications like processing.

However, the recurrent Neural networks is running on the thought of utilization of the output of every layer as input for subsequent layers. Similarly, the RNN is compatible with those applications which may be getting sequential
information such textual content and signal reading measurements. While, the transfer learning is that the concept of utilizing the Pre-skilled community and move the discovered version into replacement model. The new model also can take new additional educational information and changed neural layers. This take a look at, for the purpose CNN structure (as an in deep algorithm) and numerous model networks for analysis of COVID-19 instances (a transfer learning algorithm) were applied.

VI. IMPLEMENTATION

We have used Xray pictures to diagnose Coronavirus with the help of deep learning. We will be using Xray pictures which are available publicly to detect the covid-19 patient. Data processing is differentiated into three parts i.e., Gathering Dataset, Splitting of Dataset and Balancing of Dataset.

In Gathering Dataset, we have to detect COVID-19 we use images of X-ray from these sources.

Normal X-ray dataset images of X-ray(pneumonia) from Kaggle comprising of 5856 X-ray images (1583(Normal)+4273(pneumonia). Only Normal X-ray Images are taken for the study from Chest X-Ray Images (pneumonia), Covid Dataset Covid X-Ray Images were collected from GitHub Repository. There are 321 X-ray images taken for the study from ieee8023.

In Splitting of dataset, entire dataset is divided into two categories namely test and train in the ratio of 8:2. That means 80% of train data and 20% of test data.

In Balancing Dataset, dataset is highly imbalance because it contains very less Covid images as compared to normal images which is not recommended for train the model. In order to balance the dataset Image Augmentation technique is used. Image Augmentation is used to generate more samples from single sample. This can be done by shifting, zoom rotating, etc. Out of many options we have used four methods namely zoom ,width shift ,height shift and rotation.

Table 6.1: Balanced dataset after image augmentation

Label	Train	Test	Total
Normal	2532	317	2849
Covid	2558	64	2622
Total	5090	381	5471

6.1 WORKING ON MODELS

Transfer Learning approach is used for the study due less amount of data present for training the model. Machine learning is the again using of a trained model on a new data. Diverse mainstream and recently announced effective CNN based pre-found learning calculations were prepared, approved and tried for arranging Normal and Coronavirus patients utilizing chest X-ray images. Stratified 3-overlay Cross Validation is utilized for assessment in which 20% of the training data for validation.

VII. PERFORMANCE EVALUATION

Model is evaluated on different performance metrics i.e., Accuracy, precision, f1-score, Sensitivity, Specificity

7.1 Accuracy

Accuracy proves that how many specimens are accurately classified.

7.2 Specificity

It is the rate of finding negative specimens accurately.

7.3 Sensitivity

Sensitivity might be characterized as the quantity of positives returned by our DL model.

7.4 Precision

Precision is approached as the quantity of right reports returned by our DL model.

7.4 F1-Score

F1-score is the function of sensitivity and precision, which is to found equality between Pre and Sen.

VIII. DISCUSSION

Summary one on classification, division, and prediction are presented. The overall number of investigations directed are Segmentation, Prediction, Classification of Coronavirus using the Deep Learning algorithm. We can see that from the figure which is the highest work has been done on the diagnosis of Coronavirus patients, and the minimum work is done on prediction due to lacks of free available databases which is used to develop CT-Scan and X-ray images for segmentation and Classification in Deep Learning algorithm. The overall number of models is used in this study are four. This might be because of low registration charge and that selection slice is not needed. Other than this, very few researches have used combined methods of DL, because of lack of such a wide COVID-19 X-ray images database.

IX. CHALLENGES

With the growth of Coronavirus globally, we have faced many significant problems. Signing and implementing CADS for diagnosis and detect the disease. Associated with the most important challenges COVID-19 data availability is a DL network architecture Fixing, and hardware resources. very less availability of large databases include X-rays and CT images is one of the most challenge in our project. Due to the shortage of patient data, we used already trained networks like VGGNET, ResNet, etc. Nevertheless, number of studies were conducted. One of the challenges is that while playing already trained network in these models are trained on the collision of IEEE8023 database and Chest X-Ray images that is completely unlike from medical images. Therefore, applying efficient CADS for accurate and rapid diagnosis CT images or Coronavirus from X-ray or is still a difficult work. X-rays or CT-scans Images of subjects are not fully satisfied by Physicians and researchers for accurate diagnosis of Coronavirus patients; They can utilize both methods concurrently. So, full and extensive databases of X-ray and CT-scan hybrids CADS is not a framework for research and implementation the scope of machine learning has been delivered for researchers. For this reason, the researchers separately operate X-rays and CT-scan datasets from other datasets, which can be interrupted Network training. Integration of X-ray and CT-scan yield the dataset leads the way in helping to quickly identify COVID-19 With DL

network. Third challenge in the data section Non-reporting of phenotypic information like age is our next challenge. Use of this knowledge can make amendments and increase in performance of Deep Learning model.

Summarize the Deep Learning based segmentation algorithm X-ray focus on find suspicious areas of Corona in X-ray images. Is one of the problems with the database is that lack or ground reality for Coronavirus image segmentation fields. So, we have Therefore, many researchers have delimited Trained these areas and models with the help of deep learning Such as that model, which is time consuming. As a result, there will be presence of a devoted database of fragmented images help to achieve the best performing model. Also, it becomes easy for compare to other authors working on the similar images. To predict the spread of corona using Deep Learning algorithm, the nature of coronavirus is still relatively undisclosed, And the possibility of mutation is a big issue. So, the generality of the infection is estimated, such as several factors the average age of society to inhibit the spread of policies Diseases by countries, climatic conditions and infections of a friend, neighbor, family. shortage of applicable proper hardware tools is next. Implementing DL Architecture in CADS in Corona Diagnostics demands strong hardware resources, which is unfortunately not normally accessible to many researchers. However, tools like Google Colab have partially reduced this the problem is to employ these gadgets in reality approach is still big problem. Still challenging. That is why, in major studies, researchers Web or the like we did not provide practical CADS systems Windows software to detect Coronavirus.

X. CONCLUSION AND FUTURE SCOPE

Coronavirus is a rise pandemic infection. Even a short period of time can seriously put a risk to the health or even life also of many people all around the world. It straight influences lung cells, and may be not be cured if not detected early damage which put a risk to the health or even life. In our study, the detection of Coronavirus was made using the DL network, X-ray images of Coronavirus which is freely available databases accessible. DL Model are employed for diagnosis, division and detection of prevalence. DL are being used for better performance and accuracy. This work is done to detect Covid-19 using deep learning based transfer learning approach in which four keras models namely VGG16, VGG19, ResNet50, InceptionV3 were used. These models were trained ,tested and validated on 5471(2849 Normal + 2622 Covid) images. All the models were evaluated on five performance metrics accuracy, precision, F1-score, Sensitivity, Specificity. All the models are performing well to identify Covid and Normal images. Among these models,VGG16 and VGG19 are showing better results than ResNet50 and InceptionV3.By small margin VGG16 outperforms VGG19.Publicly available databases should be increased in future for researchers to explore better DL models and accurately predict COVID19.

Table 10.1: Average Performance Metrics For Deep Learning Models

Models	Accuracy	Precision	F1-score	Sensitivity	Specificity
VGG16	99.49	99.48	99.48	99.80	99.16
VGG19	99.15	99.16	99.16	100	98.29
ResNet50	96.77	96.96	96.77	94.09	99.44
InceptionV3	93.73	94.21	93.70	92.01	95.45

If we want to solve this problem as early as possible, our work gives a good knowledge of how different methods of deep transfer learning can be used to identify covid patients. We believe that this way we can reduce the number of deaths due to Coronavirus by instant detection of covid positive patients and separate them with the covid negative people.

One of the challenges of developing a strong and accurate Coronavirus diagnostic system is not having a wide public availability database. We vigorously think that, with freely available databases, can be made by researchers in future to explore better DL models and accurately predict COVID19. In addition, developing accurate segmentation models is challenging and the second challenge is to have an accurate ground reality. Summary of the work are done on classification, division, and prediction. In this project we have detected covid-19 with high accuracy in vgg16 among inceptionv3, ResNet50, Vgg16 and Vgg19. Our research will help doctors to make an accurate decision due to our higher accuracy and performance. If we want to contain this disease as early as possible, this work gives a good knowledge of how different methods of deep transfer learning can be used. We believe that this way we can reduce the numbers of death because of Coronavirus and we can stop Coronavirus with greater success.

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