Early Detection of COVID-19 Virus In CT Scan Images using CNN B.TECH

PROJECT REPORT

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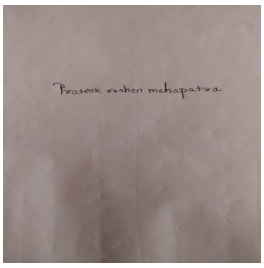
UNDERTAKING

I hereby declare that the work presented in this report titled "Early Detection of COVID-19 virus in CT scan images using CNN", submitted to the Department, International Institute of Information Technology, Bhubaneswar, for the award of the Bachelors of Technology degree in Computer Science and Engineering, is my original work. I have not plagiarized or submitted the same work for the award of any other degree. In case this undertaking is found incorrect, I accept that my degree may be unconditionally withdrawn.



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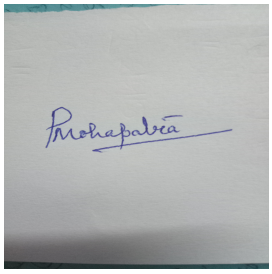
CERTIFICATE

Certified that the work contained in the thesis titled "Early Detection of Covid-19 virus in CT scan images using CNN", by Prateek Roshan Mahapatra, Roll Number B116037 has carried out under my supervision and that this work has not been submitted elsewhere for a degree.



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Contents

1 Introduction **8**

2 Usage of ML Against COVID-19 **9**

3 Related Work **13**

4 Methodology **16**
4.1 Problem Statement 16
4.2 Dataset Description 16
4.3 Implementation 16
4.3.1 Model Learning rate 16
4.3.2 Batch Size 16
4.3.3 Sampling 17
4.3.4 Pre-Trained Model 17
4.3.5 Epochs 19

5 Results **19**
5.1 The Final Accuracy And Loss 19

6 Conclusion **20**

Abstract

The sudden increase in COVID-19 patients is creating panic for everyone.That's why testing kits are also getting limited so it is not possible to use RT-PCR tests for identifying the patients.So in this scenario we can use X-Ray images to identify patients.Because X-Ray machines are available everywhere.Also no travelling time is required.SO in this paper we are going to discuss how we can use X-ray images to detect COVID-19.For this we have used a pre-trained model which is Efficientnet-b3.This can help in those areas where it is difficult to chose between whether to keep the patient along side the other patients in the hospital or should islolate them.During this work by using recent approaches i developed a model on a publicly available Data set which got an accuracy of 0.99.
Keywords :CNN,Covid-19-Diagnosis,Detection,ML,DL

1 Introduction

COVID-19 was found in China as the first case was reported in Wuhan, China on December 21,2019.Till now as of 20 January 2021 102,095,589 patients were possitive with 2,202,206 Deaths.The infection was transmitted from animal to human. The virus has spread everywhere in the planet. [1].Human-to-human virus transmission is most common when humans are in close proximity.To curb the effect of COVID-19 human to human interaction should be minimized.WHO suggested infection prevention measures such as don't get into contact with diagonised patients,washing hands frequently also after contact with patients, and unprotected contact with any animal should be avoided. Cough protocol dictates that people with an acute respiratory tract infection should maintain distance,not coughing openly, sneeze with handkerchief or tissue papers, and washing hands frequently. Healthcare facilities have deployed extraordinary measures to combat the virus's spread, efforts to treat infected people and to screen the general population for coronavirus diagnosis Governments did all they could to contain the outbreak while still meeting the demands on the healthcare system.

As a result, data may come from a variety of sources, including patients, who are divided into genetic, social, and population groups, all of which helps to prevent and fight against COVID-19 [2]. However, due to the task's difficulty, this has been extremely challenging in relation to COVID-19. Machine learning is a basically finding patterns in data and learn from them. Machine Learning, according to [3], played a vital role against COVID-19. Efforts are still being made, such as the Patients' screening, identification, and tracking, medicine and vaccine development associated with COVID-19.

The key contribution of this research is the creation of a completely new deep neural network model to predict whether a patient is COVID positive or not with the help of X-ray.Non-radiologists view radio-graphs in the current setting in the vast majority of situations.Furthermore, given the virus's novelty, many radiologists might not be well educated with the virus and might lack useful skills to diagnose.Therefore our algorithm can be used as a reference for healthcare systems.

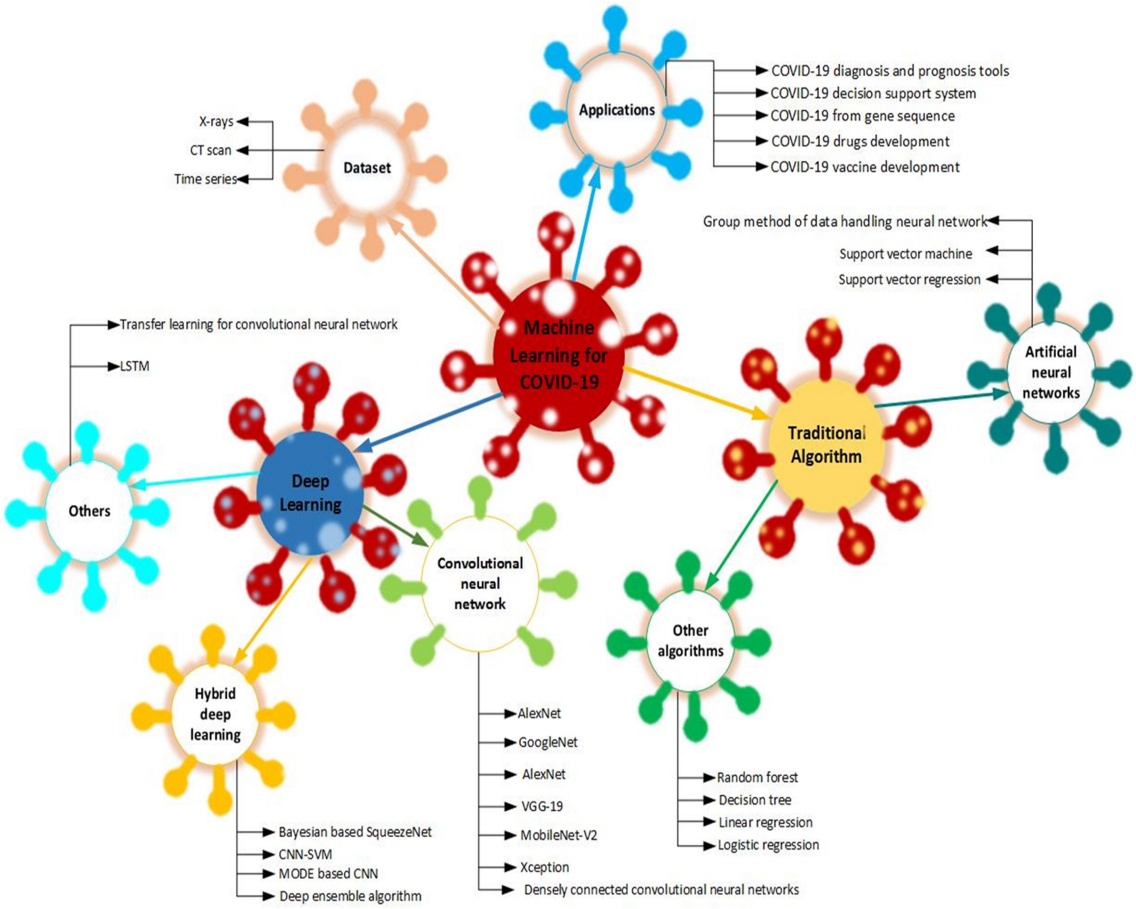

Figure 1: Various applications of AI against Covid-19

2 Usage of ML Against COVID-19

Two AI firms, BlueDot and ,correctly predicted the COVID-19 outbreak.BlueDot gathered vast amounts of heterogeneous data from a variety of outlets, including news stories,outbreaks in animal,world-wide infection warnigs etc..Then to concentrate its attention it used various filters; it used various machine learning and NLP techniques for detecting, label, and the frequency of risk to COVID-19.Also the time of the transmission outbreak was predicted before.Therefore BlueDot correctly forecasted the outbreak 9 days before the outbreak is being declared publicly.

To model the distribution of Covid-19 [4] used logistic regression.The Bayesian regression technique is used to calculate model parameters.Researchers claim that covid-19 experts can set up prior distributions which can help for limited datasets. Polynomial regression was used by [5] to predict the total number of cases in India.Basically researchers used training data to give predictions of the total number of COVID-19 patients in India for the coming two weeks.The

global distribution of COVID-19 was estimated by [6].The models showed excellent prediction accuracy for short time series and can be used to capture various patterns. S-Curve (logistic curve) method was used, which assumes convergence.[7]used a quasi-Poisson regression model to predict the total number of recorded cases in Italy.To compute the differences in confirmed case patterns, an interaction model is used.

[8]by using an automated tool to collect regular verified data related to covid-19 and also the articles from internet like MediaCloud,PHE.94 patients with reported COVID-19 with their pharyngeal swabs, [9] found the highest viral load.

To get the infection status of Covid-19 [10] developed some technical methods.A statistical theory-related estimation method for identifying the prominent feature of each time and predicting the epidemic's movement.Also various SIR and SEIR models have also been implemented for this purpose[11, 12, 13, 14].

six machine learning methods were utilized,including CUBIST, RF, RIDGE, SVR, and stacking-ensemble learning, as well as the ARIMA statistical model, to forecast the total reported cases basically one, three, and six days ahead in ten Brazilian states with a high regular occurrence.To predict the movement of Covid-19, the Google trends website was used to gather information.Using LSTM and linear regression were used to predict the total cases.To compare both models 10-fold cross-validation was used.

India is a densely populated country.That's why researchers tried to predict outbreak patterns in India based on the outbreak in china.Publicly accessible dataset was used for the model.From Jan 22, 2020, to April 3,this dataset contained the regular numbers of total cases that are reported,number of recorded cases, and the total number of the death cases.

Deep LSTM was used to predict when the Covid-19 is going to end and transmisiion of the virus in canada.Canada's transmission rate was comparable to that of the United States.Outbreak of the virus can help decision makers to monitor the covid situation in monitoring the COVID-19 situation and preventing tepidemic from spreading further in the country.Researchers used various AI approaches to derive important features from publicly available data and to give a prediction of patient's mortality.

Six algorithms were used to give a prediction on patients mortality.The data was collected from patients 76 countries around the world.Researchers use random forest to study about 484 COVID-19 patients and found most significant features and it's effect on mortality. Patients over the age of 62 have high chance of death, according to research.

To curb the effect of COVID-19, most countries implemented various types of regulation, social distancing,Closing of schools and companies.Person,detecting temperature in patients,tracing the person from video,tracing through contacts, chat-bots,and other machine learning and deep learning technologies

have been widely used in disease control and social management, including individual, temperature detection, video tracking, contact tracking, and intelligent robots.So many countries around the globe are using AI devices to identify patients in public areas like airports,market places and train stations.In addition, video detection technology based on deep learning is used to identify patients in crowded places[15].

Furthermore, and passing person's identification information was collected at city entrances and exits.Machine learning is being used properly with passing someone's travel history and trajectory to see whether they are from a COVID-19-affected area[16, 17]. Touch monitoring of COVID-19 patients also makes use of AI technologies [18]. Personal data can be combined for each patient to determine the possible transmission trajectory[19]. To see the effectiveness of social control methods for preventing COVID-19 spread [20] proposed a model. The used model assessed the maximum cases being monitored per week by increase in criteria such as touch monitor and number of quarantined cases.[21] developed a statistical model to evaluate the influence of interventions in United kingdom.He suggested some steps to retain successful COVID-19 regulation. [22] tested various social isolation techniques on the complex transmission of COVID-19 using Singapore population and personal behaviour data in an influenza epidemic simulation model. The ability for automated summary aspect mastering has had an impact on the efficacious use of ML when combined with a large amount of data. Discovering appropriate drugs and vaccination were two important areas where ML helped with predicting certain properties,prediction of it's behaviour of the reaction, and interactions of ligand and proteins.mProteomics and genomics experiments were used to caution diverse drug improvement applications and vaccines for Covid.One of the most major contributions is to improve prescription drugs, and its a vital feature against Covid-19.ML and DL are used in field design and to perform fast-paced test to precisely reflect output thanks to the creation of a predictive learning model. With a drug rehabilitation procedure.To fight against the virus AI can help us discovering drugs.

Table 6 Summary of COVID-19 data sources and accessibility.

Reference	Data	Owners	Source/Accessibility	Remarks
Apostolopoulos & Mpesiana (2020), Ozturk et al. (2020), Salman et al. (2020), Toğaçar, Ergen & Cömert (2020), Ucar & Korkmaz (2020) and Loey, Smarandache & Khalifa (2020)	X-Ray	Cohen	https://github.com/ieee8023/covidchestxray-dataset	A project with a collection of X-rays images
Apostolopoulos & Mpesiana (2020)	X-Ray	Kaggle	https://www.kaggle.com/andrewmvd/convid19-X-rays	Dataset_1: 224 images with Covid-19, 700 images with common bacterial pneumonia, and 504 normal images condition Dataset_2: 224 cases of Covid-19, 504 healthy instances, and 714 has both bacterial and viral pneumonia
Ardakani et al. (2020)	CT scan	Ardakani et al. (2020)	16-MDCT scanner (Alexion, Toshiba Medical System, Japan)	The data contained 1020 CT slices from 108 patients confirmed COVID-19 and 86 patients without COVID-19
Ayyoubzadeh et al. (2020) and Vaid, Cakan & Bhandari (2020)	Time series	Worldometer	https://www.worldometers.info/coronavirus/	The daily new COVID-19 cases from 02/ 15, 2020, to 03/18/2020 in Iran. Dataset features: previous day's search trends, previous day cases, and Output: new cases of the current day
Barbosa & Fernandes (2020)	Genome	Barbosa & Fernandes (2020)	https://data.mendeley.com/datasets/nvk5bf3m2f/1	The data is chaos game representation of SARS-CoV-2 containing both the raw and processed data with 100 instances of SARS-CoV-2 genome
Butt et al. (2020)	CT scan	Butt et al. (2020)	Butt et al. (2020)	The data comprised of 618 CT scan samples including 219 from 110 COVID-19 patients
Chimmula & Zhang (2020)	Time series	Johns Hopkins University and Canadian Health authority	Chimmula & Zhang (2020)	The data is available in time series: date, month and year up to 31/04/20
Huang et al. (2020b)	CT scan	Huang et al. (2020b)	Huang et al. (2020b)	126 COVID-19 patients that underwent a CT chest scan from 1/1/2020 to 3/2/ 2020
Li et al. (2020b)	CT scan	Li et al. (2020b)	Li et al. (2020b)	Data from 3,322 patients comprising of 4356 chest CT scans. Data collection period from 16/08/2016 to 17/02/2020
Liu et al. (2020a)	Time series	1. Tencent news 2. Baidu	Real COVID-19 reporting: https://news.qq.com/zt2020/page/feiyan.htm?ADTAG=area Baidu: http://qianxi.baidu.com	1. COVID-19 time-series data including locations confirmed cases, deaths, recovery cases, and new diagnosed cases 2. Baidu is an open-source for big data project that provides visualization of population migration
Oh, Park & Ye (2020)	X-ray	Society of Radiological Technology	Oh, Park & Ye (2020)	Segmentation network dataset with a total of 247 posteroanterior chest radiographs

Figure 2: Covid-19 Data sources and availability

3 Related Work

ML and DL can help during development of diagnostic tools and treatment decisions[23]. The most common complication of COVID-19 is lung infection or pneumonia, and computed tomography (CT),played a vital role in the diagnosing the disease. COVID-19 treatment and screening can be more successful.Therefore various ML and DL based tools are used to fight against the virus.[24] created a computer-aided diagnosis (CAD) device that can detect cancer.COVID-19 samples were taken from stable and pneumonia cases.Research proved the efficacy of using several transfer learning techniques to identify covid-19.[25] used various types of CNNs against COVID-19 such as Alex-Net, Xception, VGG-19, ResNet-18, SqueezeNet, ResNet-50, GoogleNet, MobileNet-V2, and ResNet-101.All CNN variants were added on CT scan images.

Other CNN variants were outperformed by Xception and Resnet-50 in detecting the virus, according to the CNN variants' diagnostic data. ResNet-50 has a high sensitivity in identifying Covi-19 infections, according to the researchers. As a result, it can be used as an additional instrument in the radiology department to diagnose COVID-19 infection.[26] proposed a joint model comprising of CNN,SVM,RF, and multi-layer perceptron while predicting.The CNN performance and various algorithms were combined to predict covid-19 infection. COVID-19 infection in patients can be detected quickly with this diagnostic method.

To estimate the magnitude of COVID-19 logistic regression was used. The study's findings suggested that CT quantification can also give a prediction of how the virus is progressing from a mild stage to a severe stage.This wwill help in indiacting the prognosis of virus.[27] used a ML algorithm to give a prediction of the total magnitude of the virus.A method was suggested that can predict the patients that are at risk.This research could help in making the best use of limited resources.[28] developed a Covid-19 a method for detection based on CNN.Covid-19 was detected using CNN–inception V3 on 133 X-ray images of various patinets infected with COVID-19 and the same amount of regular X-ray images. Their findings showed CNN–inception V3 can help in detecting Covid-19 from X-ray images. For identifying COVID-19 in patients,a GAN and CNN variant were used.The objective behind this is to collect all the images for Covid-19 and to produce more images by using GAN to help in the identifying this virus from X-ray images that are publicly available and with the highest accuracy of images.Deep transfer learning models Google-net, Alex-net, and Res-Net18 were used. They discovered that in the four-, three-, and two-class classification problems, Alexnet scored 82.6 percent,Googlnet 85.2 percent, and 100 percent.

[29] used Squeeze-Net (a predefined CNN) and the Bayesian optimization method to create a fast COVID-19 diagnostic tool. The Bayesian optimization approach was used to optimise the Squeeze-Net hyper-parameters.To de-

tect the virus Squeeze-net was used on labelled images that are, pneumonia, and Covid-19 using optimization.Squeeze-Net defeated the other diagnostic tools and showed better accuracy than previous models to diagnose Covid-19.[30]Based on fuzzy color used CNN to manipulate social mimic.The data was then trained using CNN, and the features were processed by using an optimization algorithm.For classifying Covid-19, regular X-ray and pneumonia imagery based on the persuasive characteristics.[31]developed an automated method to diagnose Covid-19 from CXR images using a convolutional neural network. A network with 15 convolution layers and on each convolution layer there is a different filter and was used to test binary and multi-class categories. The model can be used to test patients for COVID-19 early and can help the radiologist validate COVID-19 screening.

Drop weights based CNNs were used on a total of 5,941 CT images for four groups by [32].(1,583 normal, 2,786 bacterial pneumonia, 1,504 viral pneumonia, and 68 COVID-19). They discovered that prediction uncertainty is inversely proportional to prediction accuracy. They believed that the availability of uncertainty-aware deep learning would enable AI to be used more widely in the future.[33] used CNN and pretrained Alex-Net models to analyse 130 COVID-19 X-ray scans and 367 COVID-19 CT scans obtained from various locations. The tests revealed that the used models can provide accuracy of up to 98 percent when using a pre-trained network and 94.1 percent when using a changed CNN.

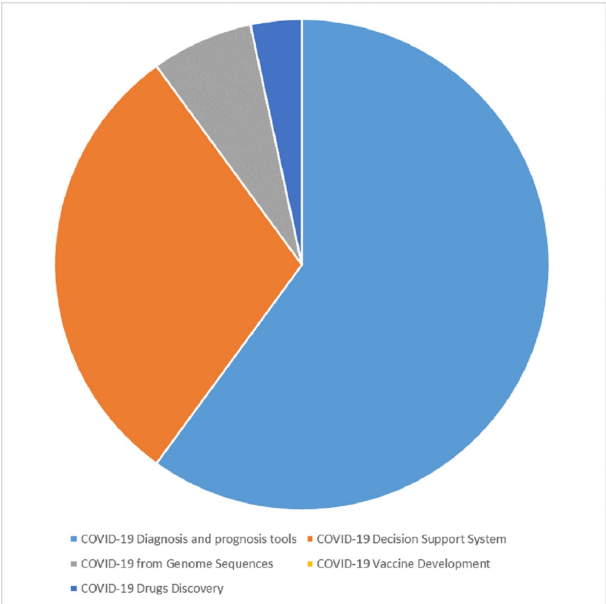

Figure 3: Uses of AI against Covid

Authors	Algorithms used	Performance	Description	Benefit
Apostolopoulos& Mpesiana	Transfer Learning with CNN	Accuracy: 98.75%	Device approach for automatic diagnostic of COVID-19 based on X-ray	Cost-effective, fast diagnosis and reduce exposure of medical workers to COVID-19
Ardakani et al. (2020)	Variants of CNN ResNet 101	Accuracy: 99.51% Sensitivity: 100% Specificity: 99.02%	Automated characterization and diagnosis of COVID-19 infection.	Cheaper and faster compared to the traditional laboratory analysis of COVID-19. Reduces medical worker's workload.
Butt et al. (2020)	CNN	AUC: 0.996 Sensitivity: 98.2% Specificity: 92.2%.	Outperform the traditional RT-PCR testing of COVID19	fast and reliable in detecting COVID-19 pandemic.
Huang et al. (2020b)	Deep learning algorithm	Not Applicable as a result of ANOVA analysis	The assessment of the lung opacification measured is significantly different from the clinical groups	The approach has the potential to remove the subjectivity in the initial evaluation of COVID-19 findings as well as follow up pulmonary
Li et al. (2020b)	CNN	Sensitivity:87% Specificity:92% AUC: 95%	The automated framework that differentiates COVID19 from pneumonia	Automated the COVID-19 testing process, reduces the testing time and fatigue.
Lin et al. (2020a)	P-CNN	Sensitivity: 100% Precision: 76.9%	Diagnose COVID-19 with limited data and present new probabilistic GradCAM salient map	Limited amount of data can be used for the COVID-19 diagnoses, and it is interpretable.
Ozturk et al. (2020)	CNN	Sensitivity: 85.35% Specificity: 92.18% Accuracy: 87.02%	Improve efficiency and automate the COVID-19 screening process	Automate the process of COVID-19 diagnoses to reduce fatigue
Salman et al. (2020)	CNN	Sensitivity: 100% Specificity: 100% Accuracy: 100%	Automated COVID-19 screening process	Reduces diagnostic time
Singh et al. (2020)	MODE based CNN	Sensitivity: > 90% Specificity: > 90%	Diagnose COVID-19 with better accuracy than the competitive models	The proposal is beneficial to COVID-19 real-time classification
Toğaçar, Ergen(2020)	CNN-SVM	Overall accuracy: 99.27%	Contributed to the efficient detection of COVID-19	Automated detection of COVID-19 patient
Ucar and Korkmaz(2020)	Bayesian-based SqueezeNet	Accuracy: 100%	Presents alternative rapid COVID-19 diagnostic tool based on deep BayesSqueezeNet	It will be of benefit to healthcare professionals in diagnosing COVID-19 efficiently.
Wu et al. (2020)	ResNet50	Accuracy: 0.819 Sensitivity: 0.760 Specificity: 0.811	Provide COVID-19 diagnosis from multiple view	Reduce the workload of a radiologist by offering fast and accurate COVID-19 diagnosis
Loey&Smarandache&Khalifa	Googlenet, Alexnet and RestNet18	Googlenet, Alexnet and Googlenet scored 80.6%, 85.2% and 100% in the 4, 3 and 2 classes classification problems	Generate sufficient COVID19 data to improve COVID19 diagnosis	Early detection of COVID-19 and reduce the workload of radiologist

Figure 4: Performance of other Algorithms

4 Methodology

4.1 Problem Statement

The main goal of the algorithm is to predict whether the person has been affected with covid-19 or not by using X-ray image as an input to the network.So we should train the model with a series of appropriate images that are being labelled by healthcare professionals and radiologists.So with this deep learning algorithm we can diagonise covid-19 faster and also in those areas where RT-PCR test is not available.

4.2 Dataset Description

The Training dataset consists of professional radiologist classified 15264 (512x512 pixel) images.A total of 420 images from the same distribution are in the test dataset.we discovered that the training dataset is heavily oversampled.Even a simple algorithm that just gives the majority class as output will achieve high accuracy with substantially imbalanced sets. In other words, considering the fact that only about 10% of the population has Covid,it will declare all Covid-free and achieve a "accuracy" of 90%. Initially, we worked with the unbalanced training dataset in its current state.It might not have been the best place to start in retrospect.

4.3 Implementation

In this section We'll discuss how each of the hyper-parameters were being selected during the training process of the model.

4.3.1 Model Learning rate

We can achieve better convergence with a significantly lower learning rate,But it wont be possibly giving the best accuracy for our model.It's possible that the problem is either the algorithm has not achieved appropriate weights which gives low error on the test dataset. On the other hand, a faster learning rate may cause the algorithm to overshoot the required set of weights.In this paper we tried with various learning rates such as 0.01,0.001, and 0.0001 and at last 0.0001 gave the lowest error rate.

4.3.2 Batch Size

I ran into memory problems when I increased the batch size to 256 or even 64, so then i went for a smaller batch size I tried 30 and 15 as well. With a learning rate of 0.0001, the batch size 30 produced the lowest error rates of the two batch sizes.For the VGG-16 CNN, the writers experimented with different

learning rates and batch sizes. I began with a learning rate of 0.0001 instead of 0.001, which later gave me the best result and the batch size was set to 32, which is normal in Machine learning practice.

4.3.3 Sampling

At first I didn't sample anything at all. Surprisingly, the model classified almost all of the test cases as "1," despite my expectations of "0." Initially i believed the transformations on the test set are not being applied , and the untransformed images from the test set resembled the transformed images from the images in training set of mark "1".Then, in the training dataset, I used a weighted random sampler, which resulted in a nearly 50–50 representation of the 0 and 1 groups. However, it resulted in a reduction in the total dataset size of the train dataset from 15340 to just under 3200.With this sampling method, accuracy increased but plateaued at about 0.86. After that, I had to use over-sample technique from the less-numbered class to get the total number of images.My training dataset grew from 15000 to 26000 as a result of this. This improved a lot because my accuracy was now in the 90s and I was getting about 0.94.

4.3.4 Pre-Trained Model

Training a model from scratch can be very tedious.That's why in this paper we are going to use the pre-trained model of Efficient-net.At first we used VGG16 or Resnet50, but after reading the paper on Efficient=net[34] i wanted to implement this model for our project work.I started with Efficientnet b7, but i did not have enough computatuinal power.As a result, I chose Efficientnet b3.The only reason I did so at the time was because it was the Efficientnet family's largest model, which finally fit inside my GPU memory.There are three scaling dimensions of a CNN: depth, width, and resolution. Depth simply means how deep the networks is which is equivalent to the number of layers in it. Width simply means how wide the network is. One measure of width, for example, is the number of channels in a Conv layer whereas Resolution is simply the image resolution that is being passed to a CNN. The figure below(from the paper itself) will give you a clear idea of what scaling means across different dimensions. We will discuss these in detail as well.

Scaling a network by depth is the most common way of scaling. Depth can be scaled up as well as scaled down by adding/removing layers respectively. For example, ResNets can be scaled up from ResNet-50 to ResNet-200 as well as they can be scaled down from ResNet-50 to ResNet-18. But why depth scaling? The intuition is that a deeper network can capture richer and more complex features, and generalizes well on new tasks.Easier said than done! Theoretically, with more layers, the network performance should improve but practically it doesn't follow. Vanishing gradients is one of the most

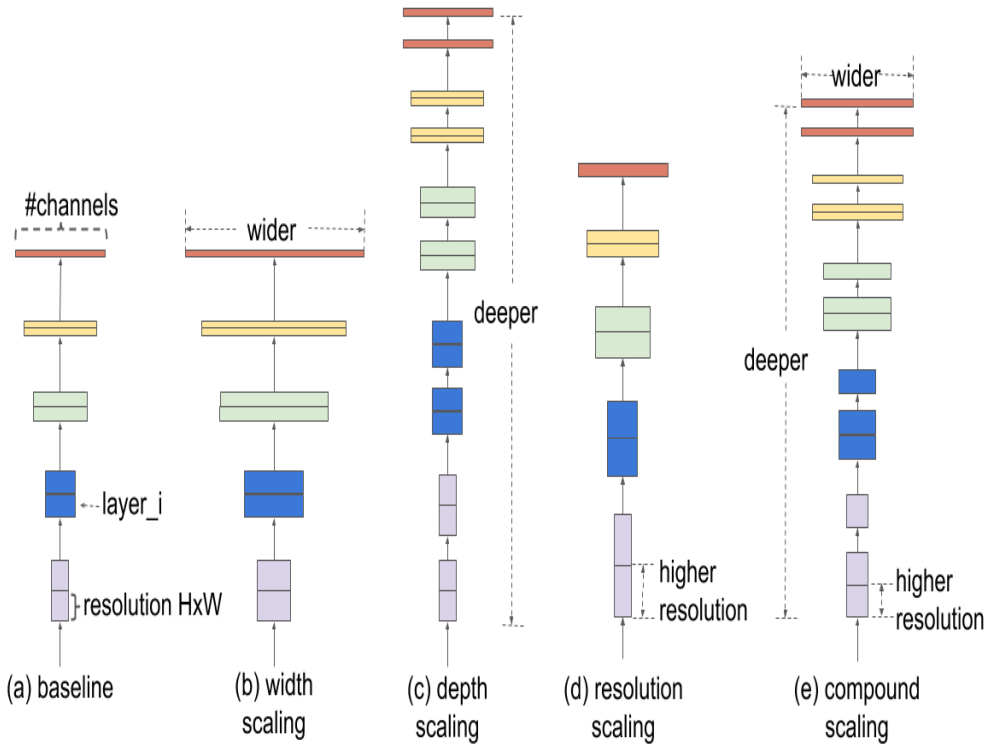

Figure 5: Efficient-net Model Architecture

common problems that arises as we go deep. Even if you avoid the gradients to vanish, as well as use some techniques to make the training smooth, adding more layers doesn't always help. For example, ResNet-1000 has similar accuracy as ResNet-101.Intuitively, we can say that in a high-resolution image, the features are more fine-grained and hence high-res images should work better. This is also one of the reasons that in complex tasks, like Object detection, we use image resolutions like 300x300, or 512x512, or 600x600. But this doesn't scale linearly. The accuracy gain diminishes very quickly. For example, increasing resolution from 500x500 to 560x560 doesn't yield significant improvements.Intuition says that as the resolution of the images is increased, depth and width of the network should be increased as well. As the depth is increased, larger receptive fields can capture similar features that include more pixels in an image. Also, as the width is increased, more fine-grained features will be captured. To validate this intuition, the authors ran a number of experiments with different scaling values for each dimension. For example, as shown in the figure below from the paper, with deeper and higher resolution, width scaling achieves much better accuracy under the same FLOPS cost.

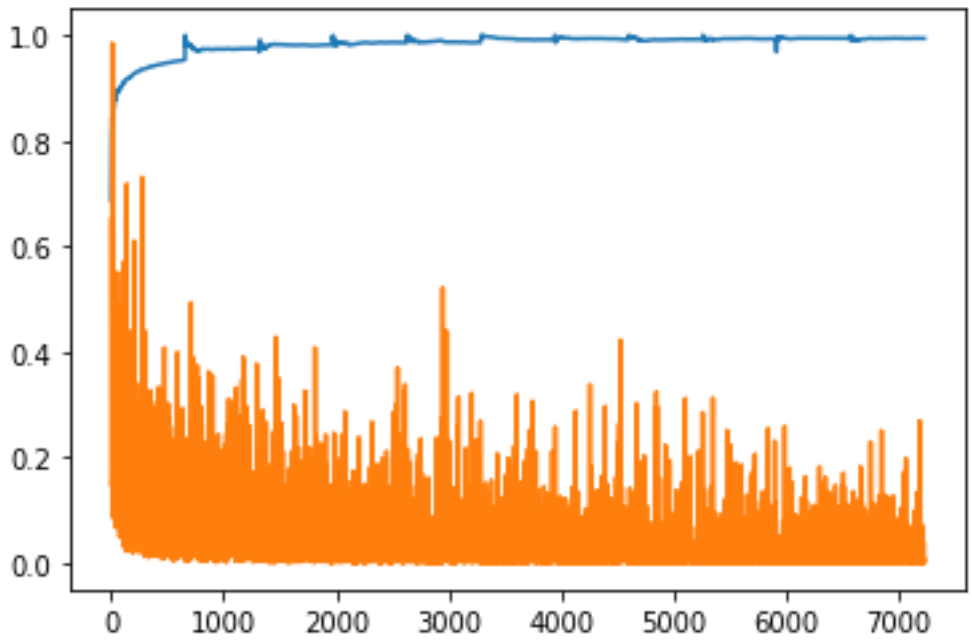

Figure 6: Loss-Accuracy

4.3.5 Epochs

For over training of a model like Efficientnet b3,it is not that difficult which has more than 13 million parameters and lakhs of training datasets.But in reality, while training our model with 20 Epochs,and got a training accuracy of 1.Then i started using epochs within a range of 1 to 20 with different learning rate and batch size combinations.At last i found 11 as the optimal epochs for me.

5 Results

5.1 The Final Accuracy And Loss

The final accuracy level of the deep learning model is recorded as 0.99 and the loss is recorded as 0.04. Also, accuracy-loss evolution values can be observed in the Figure.The deep learning model identifies almost 0.99 of the images right and distinguishes between the infected and not infected lungs, which is that the first target region of the physical body.Fig6 shows training-accuracy and loss over various iterations. As the number of patients grows, inspecting and diagnosing this large number of cases becomes more difficult. A strong computer,on the other hand, can diagnose billions of patients in a single day. After the 11th epoch,we have an accuracy of 99% on the train data-set for both the classes i.e. Covid positive or not covid-positive.

6 Conclusion

The CT scan is helping doctors and healthcare professionals in identifying the infected patients.CT scan is being used as a diagnostic criteria for COVID-19. Based on X-ray images CNN is the algorithm that the researchers used to create the diagnostic method.MOst of the data that are being used in identifying the virus is in images that's why CNN has wider range of applications against Covid-19.Apart from all this CNN is well known for its accuracy, efficiency, and reliability in computer vision tasks as compared to other traditional algorithms.In this paper we demonstrated how a deep learning model based on CNN can be used to identify covid-19.The results look promising,We obtained an accuracy of 0.99 for COVID-19 classification.We can continue on this research by providing larger datasets to our model.Also by increasing the computation power we can train the model by using higher versions of Efficient-net family like Efficient-net b7.Anyhow we got an accuracy of 0.99 which can help people in identifying the virus and to fight against it.

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