

Performance Result for Detection of COVID-19 using Deep Learning



Harit Ahuja, Shubharthi Dey, Bagish Choudhury, Aishwarya D, Sanvinoth P S S

Abstract: The 2019 novel coronavirus (COVID-19), which has sprawled fleetly among masses residing in distant nations, had a prefatory juncture in China. From both a safeness and a lucrative outlook, it has staggered the world with its hasty diffusion with conjectural vicious generic repercussions for the masses. Consequent to the escalating cases daily, there is a constricted fraction of COVID-19 inspection kits acquirable in healthcare institutions. Ergo, to obviate COVID-19 propagating betwixt masses, it is imperative to enforce an instinctive unveiling network as a prompt jack legging diagnosis appendage. The contemplated method embroils a convolutional neural network-based model, namely ResNet50, concerted with a Fully Connected Layer (FCL), reinforced by Rectified Linear Unit (ReLU) for the unearthing of coronavirus pneumonia imparted sufferer by harnessing chest X-ray radiographs. The endorsed classification model, i.e. resnet50 affirmed by FCL and ReLU, compassed accuracy of 94% for unearthing COVID-19. When equated to diverse classification models, the purported model is preminent. The aftereffect is premised on the attested X-ray images from the data appropriate in the arsenal of Kaggle.

Index Terms: ResNet50, Deep learning, COVID-19

I. INTRODUCTION

The novel coronavirus also known as COVID-19 was identified first in Wuhan which is a city located in Hubei province of China. The common symptoms that are related to COVID-19 are cough, fever, pneumonia. This disease can infect humans as well as animals. Since the last two decades [1], two types of coronavirus are observed MERS and SARS. The first was SARS which was observed in China that estimated around 8500 cases and 900 deaths. The second was MERS which was initiated in Saudi Arabia which observed 3000 cases and a total of 700 deaths. About 82 percent of sufferers of COVID-19 exhibit placid symptoms, while the others are acute.

The virus can be transmitted through droplets but it can potentially have other modes of transmission as well. Those who are found with the corresponding symptoms are put in a quarantine for about 15 days. In India, there is a scarcity of the testing kits and equipments. In this paper, the proposed system will give the performance results for the detection of COVID-19 that will help the doctors to detect the virus without the testing kits.

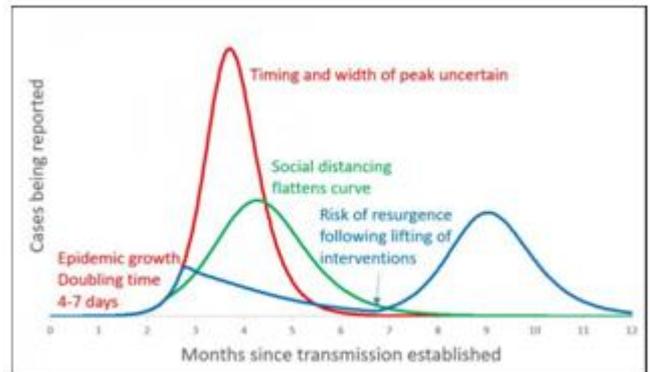


Fig. 1. Overview of COVID-19

II. RELATED WORKS

Ali Narin [2] compared three different neural networks that are InceptionResNetV2, ResNet50 and InceptionV3 by using the X-ray radiographs of chest. 5 fold cross validation technique is used to analyse the three models. The dataset for the implementation is taken from the GitHub repository of Dr. Joseph Cohen. Furthermore, 50 images of normal X-ray images of chest were taken from the Kaggle repository. Transfer learning was applied in order to increase the accuracy as the dataset was less in size. Performance metrics like accuracy, recall, specificity, precision and F1-score were used to determine the accuracy of the deep learning models. ResNet50 achieved the highest accuracy of 98% compared to other pre-trained models.

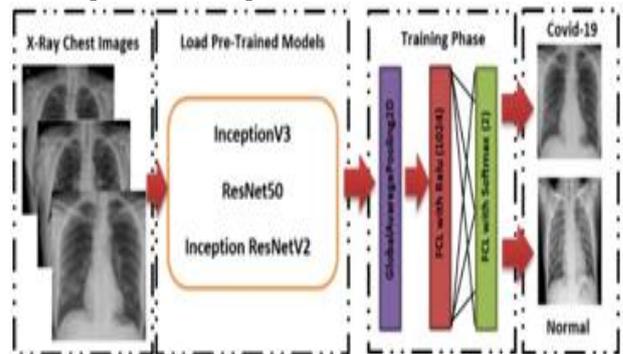


Fig. 2. Schematic Representation of Models

The paper written by Ophir Gozes [3] makes use of the deep learning image analysis and the implementation of the paper classifies between the Coronavirus and Non-coronavirus cases.

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* Correspondence Author

Harit Ahuja*, Department of Computer Science and Engineering Department, SRM Institute of Science and Technology, Kattankulathur, Chennai, India.

Shubharthi Dey, Department of Computer Science and Engineering Department, SRM Institute of Science and Technology, Kattankulathur, Chennai, India.

Bagish Choudhury, Department of Computer Science and Engineering Department, SRM Institute of Science and Technology, Kattankulathur, Chennai, India.

Aishwarya D, Department of Computer Science and Engineering Department, SRM Institute of Science and Technology, Kattankulathur, Chennai, India.

Sanvinoth P S S, Department of Computer Science and Engineering Department, SRM Institute of Science and Technology, Kattankulathur, Chennai, India.

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It makes use of 2D as well as a 3D learning model with the existing AI models.

The dataset comprised of many sources that includes 101 CT scans from Chainz, 56 CT scans of patients with positive Coronavirus from Hospital in Wenzhou in China, 6180 CT scans from El-Camino Hospital and LIDC. The first step was classification to detect slice level. The total slices that were analyzed were 270, 150 comprised of normal slices and 120 were the suspected slices of COVID-19.

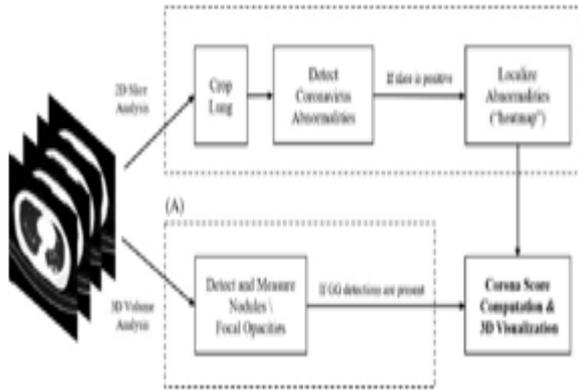


Fig. 3. System Block Diagram

In paper [4], Prabira Kumar Sethy makes clever use of SVM(Support Vector Machine) to classify the X-ray images and then it passed through Resnet50. The dataset were taken from two different sources, 25 images were taken of COVID- 19 positive cases from GitHub repository of Dr. Joseph Cohen and 25 images were taken of COVID-19 negative cases from Kaggle repository. The deep features are used for the feature extraction from a pre trained model [5]. These features are then forwarded to a classifier for the training phase. The features obtained are then sent to SVM classifier. The last step is the performance measurement of all the classification models.

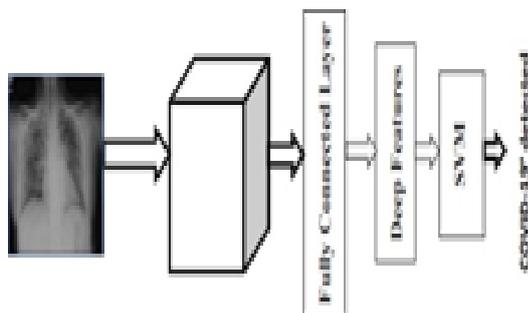


Fig. 4. Disease Identification Model

The paper written by Halgurd S. Maghdid [6] uses onboard smartphone sensors that results in an overall low cost solution. The artificial intelligence (AI) framework interprets the sensors of the smartphone to detect the amount of pneumonia and determining the disease. The paper is relying on smartphones as they have high computational power and many type of difference sensors embedded in them. The fingerprint sensor is used to determine the temperature and the inertial sensor is used to determine the fatigue level. For deep learning, CNN (convolutional neural network) or RNN (recurrent neural network) algorithms are proposed []. The machine learning algorithms used will predict the final result whether the corresponding person is positive or negative for the disease.

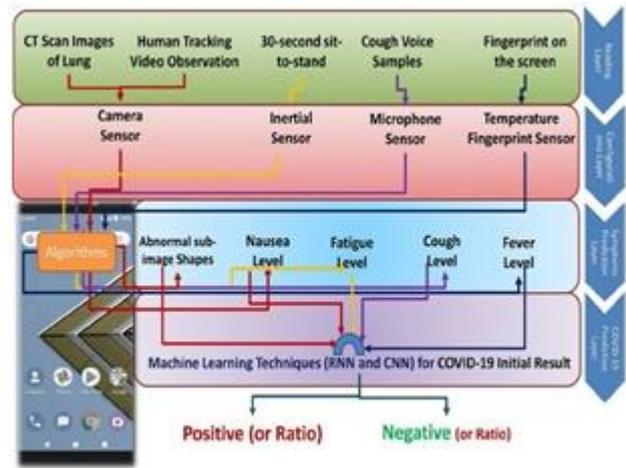


Fig. 5. Proposed Framework

In paper [7], Arni S.R. Srinivasa Rao uses several machine learning algorithms in order to improve possible cases of the COVID-19 by making the use of mobile survey. The method will implement to collect the travel history and other necessity things with the help of online based phone survey. The data will be stored and the AI (artificial intelligence) framework will do the work of processing it to determine whether the person is classified as no risk, minimal risk or high risk. People diagnosed with high risk can be put into quarantine to minimise the spread of the disease [8]. Emergency alerts can also be sent in case the patient is not able to reach a particular hospital, then an alert can be sent to the mobile health unit so that they can implement door to door testing for the corresponding virus.

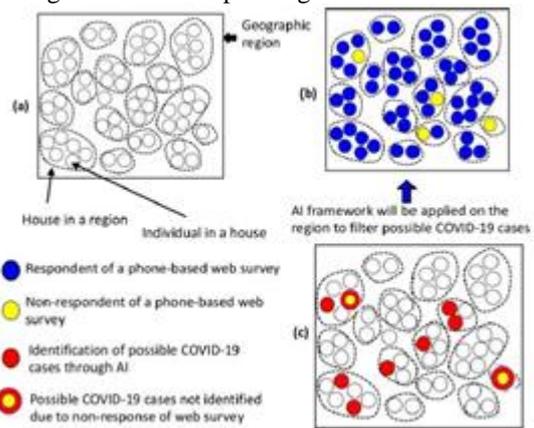


Fig. 6. Conceptual Framework of Data Collection

The paper written by Xiaowei Xu [9] aims to perform an early screening to detect COVID-19 cases from the Influenza-A pneumonia and healthy cases with the help of CT scan images with the help of machine learning algorithms. A 3D deep learning model was developed to segment out the infection regions in the CT scan images. The processed images were then categorized into COVID-19 and Influenza-A pneumonia [10]. The dataset used comprised of total 618 CT scans. The total accuracy achieved was 86.7%. The overall analysis was determined using the Bayesian function. The two deep learning classification model that were used were ResNet and the second architecture was formed by combining the location attention mechanism to the first architecture.

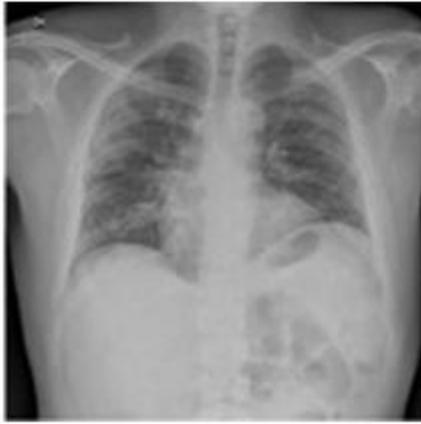
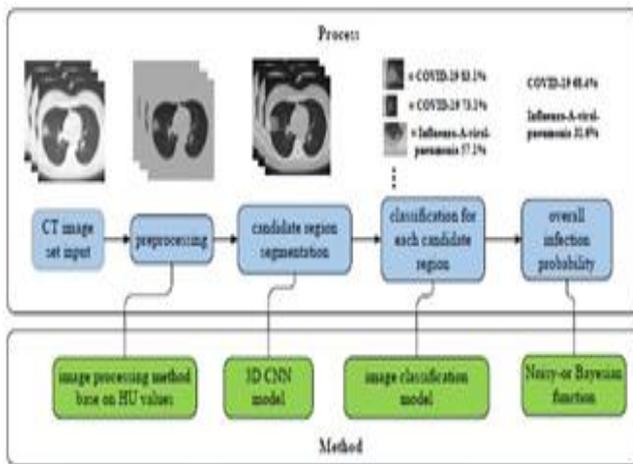


Fig. 7. Chest X-ray of COVID-19 positive patient



Fig. 8. Chest X-ray of COVID-19 normal patient



III. PROPOSED WORK

A. Overview

The dataset is taken from the Dr. Joseph Cohen’s Github repository and Kaggle repository. The dataset will be resized into 300x300 format. Bilateral filter will be applied to the resized dataset. The processed images will be passed to the ResNet50 architecture. The pre trained ResNet50 architecture will undergo the training phase. The final output will determine whether the corresponding images will be COVID-19 positive or negative.

B. Dataset

The dataset were carefully considered from two sources, i.e., the first dataset was taken from the Dr. Joseph Cohen’s Github repository for the positive COVID-19 positive cases. The second dataset was taken from the Kaggle repository which consists of the normal chest X-ray images of the pneumonia patients.

C. Pre-processing of data

The images in the dataset consists of different sizes that needs to be resized to a specific size for the easy processing in further steps. All the images in both the dataset were resized to 300 by 300 size format by a resize function. The next step of pre-processing is the bilateral filter. The bilateral filter plays the role of removing the noise in the images and most importantly, preserving the edges that will make the image crisper and clear. By applying the filter, the post processing will be more accurate.

D. Loading Pre-trained ResNet50

Resnet50 is a type of the ResNet model which consists of a total of 50 layers that includes 48 Convolutional layer and 1 MaxPool and 1 Avg Pool layer. ResNet50 is capable to train ultra deep neural network and it can train small dataset and still achieve high accuracy and great performance. ResNet50 is very accurate as it is trained from the ImageNet which consists of approximately 14 million different images. So, the pre-processed dataset passes through the ResNet50 architecture to create a model.

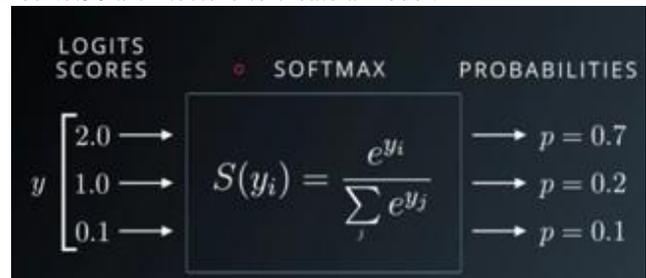


Fig. 11. Softmax Function

E. Training Phase

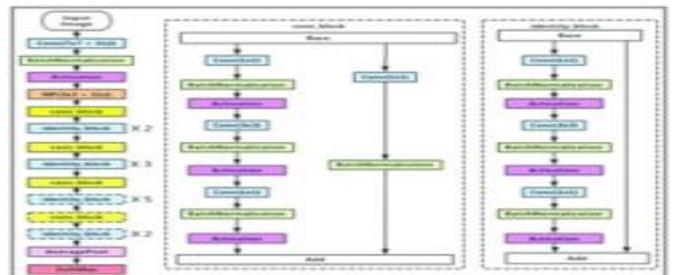


Fig. 9. ResNet Architecture

Performance Results: After all the mentioned steps, the total performance is calculated for the algorithm. The performance analysis will determine the total accuracy, recall, specificity, precision and the total F1-Score achieved. The average will be determined for the 5-folds measured and that average will determine the final result.

Global Average Pooling 2D: The Global Average Pooling is a type of operation which plays the role of calculating the output of features in the former layer. It placates the amount of total data and implements the final classification layer. It is generally an operation for spatial data type. It consists of arguments like pool size, strides, padding and data format.

V. CONCLUSION

As Coronavirus is at the peak of its disaster and has taken aback many developed and emerging economy in the last few months and it compelled WHO to categorize it as pandemic. So, with emerging scientific ways, it helps to gain more information about diseases and its preventive ways. The use of Resnet along with some existing methods of FCL, RELU and Softmax Function coupled with deep learning is an innovative way to predict coronavirus and its effect. Even though, Coronavirus is a mild viral infection but a contagious disease and can cause more harm to the country's economy. That's why, treatment of coronavirus with the help of our method is one of the most promising techniques to detect the coronavirus positive patients. As a matter of fact the only problem of our study is the limited datasets of COVID-19 X-ray for training. So, to overcome this challenge, deep transfer learning models are used. If we acquire more valuable dataset in the coming future, we will be able to work with different machine learning models.

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AUTHORS PROFILE



Harit Ahuja, is currently pursuing his Bachelor's degree in Computer Science and Engineering from SRM Institute of Science and Technology, Chennai, to be completed in the year 2020. His area of interest includes Artificial Intelligence, Machine Learning, networking and image processing. He is a CCNA certified. He represented his college in AUVSI SUAS which was held in Maryland, USA. He takes on any project that involves image processing and deep learning.



Bagish Choudhury, is currently pursuing his Bachelor's degree in Computer Science and Engineering from SRM Institute of Science and Technology, Chennai, to be completed in the year 2020. His research interest spans topics in Machine learning and its intersection with healthcare applications and/or business analytics. He aims to study the various ways Machine learning can be used to further improve upon the existing approaches using real world evidence and various learning techniques. His recent focus has been on leading research efforts to develop advanced machine learning, data mining and visual analytics methodologies for deriving data-driven insights from real world healthcare data to facilitate learning health systems. His current work primarily includes developing statistical and Machine learning methods to generate insights in the healthcare.



Aishwarya D received her B.E. and M.E. degree in Computer Science and Engineering from Anna University, Chennai, India in 2015 and 2017 respectively. She is currently pursuing her Ph.D. in CSE from SRM Institute of Science and Technology, India, where she's working on CNN models for Human Activities Recognition and Automated Surveillance. Since 2018, she's been working as Teaching Associate in SRM IST, Chennai, India. Her areas of interest include, Deep Learning, Computer Vision and Internet of Things, Edge Computing. She has previously worked on projects such as Palm Recognition, Edge Based home automation, Fire detection from Surveillance feed and has published research papers on the same.



Shubharthi Dey, is currently pursuing his Bachelor's degree in Computer Science and Engineering from SRM Institute of Science and Technology, Chennai, to be completed in the year 2020. His area of interest includes Artificial Intelligence, Web development and Machine learning and its various applications with healthcare and/or business analytics. He aims to study the various ways Machine learning can be used to further improve upon the existing approaches using real world evidence and various learning techniques. His recent focus has been on leading research efforts to develop advanced machine learning, data mining for deriving data-driven insights from real world healthcare data to facilitate learning health systems.



I'm **San Vinoth**. I am currently pursuing my bachelor's in Computer Science Engineering from the SRM Institute of Science and Technology. I'm skilled in Competitive coding and fluent in languages like C++ and Python. My Domain of interest is Data Analytics. I am also skilled in Data Visualization. I use tableau for my visualization. I do Data Entry and Data Cleansing, Crowdsourcing freelancing. Other than this, I prefer playing cricket, listening to music, and watching Animes in my free time. I am also a tech enthusiast. My LinkedIn id is <https://www.linkedin.com/in/san-vinoth-pss-23b5a297/>. Would love to work projects on Data Analytics.