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Detection of Coronavirus illness using Techniques of Deep Learning and CNN

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Abstract

A year has been passed with the global pandemic creating havocs in everyone's life. The novel Coronavirus is still raging around the globe causing catastrophic consequences on the entire health and wealth of humankind. Tests are being conducted in an insane amount on the suspected individuals. Infections that are gained through respiratory course, for example, the lethal SARS-CoV-2, are determined to have the assistance of direct identification of viral parts in respiratory examples. The two most generally utilized techniques to do this are nucleic corrosive enhancement tests through polymerase chain response/reaction (PCR) or antigen-based tests. This can take a while to generate results as there is steady increase in number of cases and causing delay in laboratories. Early detection of the virus is life saviour, if the virus is left unnoticed it can be fatal for ones' life. The current industrial era is ruled by fields of artificial intelligence and machine learning; hence this paper is an attempt to use one of these practices for novel corona virus prediction using chest radiogram images. Here dataset of Chest Roentgenogram images of patients infected with the corona virus and normal Chest Roentgenogram images are used to detect coronavirus infection. The study employs an efficient approach of application Convolutional Neural Network in predicting if the patient is affected and unaffected with the virus. The prepared model created a precision pace of 92.77% at the time of the performance preparation.

Keywords: *COVID-19, Chest Roentgenogram images, Deep Learning methods, Convolutional Neural Networks (CNN)*

1. Introduction

In the month of December Wuhan region of China reported the very first cases of the threatening Corona virus. By the end of December 2020 more than 100 million covid cases were reported worldwide. Which caused the world to go into lockdown and recession in the economy hence leading to Global pandemic. This lethal and deadly disease is ascribed to the viral particle named Severe Acute Respiratory Syndrome Corona virus.

This virus can be fatal if left unnoticed and can even cause death. However, there are symptoms of flu like cold, running temperature and difficulty in breathing. If these symptoms are noticed at an early stage, there are higher chances of full recovery of a patient. As of now there are few ways to identify if a person is infected with virus or not and using chest radiogram image for the sake of detection is one among them.

The objective of this paper is detecting if a person is infected with COVID using chest X-ray images by applying machine learning approaches. The basic idea of working of machine learning algorithm also known as classifiers is receiving the given input data, processing of the data and prediction of the output. During the training phase, the qualified model achieved a 92.77 percent accuracy rate.

The foregoing is the order of the paper: Section 2 reviews usage of various techniques employed in COVID-19 Detection. Section 3 gives the CNN Architecture used for COVID-19 prediction. Section 4

presents a comparative analysis of the work carried out. At the last, the conclusion of obtained work is presented in Section 5.

Literature Survey

COVID-19 is a brand-new disease, however it's also the primary time we have treated an international pandemic with inside the generation of large facts, similarly, to being a new organic and etiological entity. As a result, numerous calls have been made to the instructional network to apply facts science, artificial intelligence and various aspects including machine learning to combat the current situation created by this pandemic [1]-[4]. The fast-paced virus has spread across the globe, afflicting hundreds of thousands of people. According to research, this virus spreads in humans via respiratory droplets and close contact [5]. More than 140 million individuals had been contaminated with the infection as of April 1, 2021, resulting in the deaths of more than 3,000,000 individuals worldwide [6]. Absence of assets and absence of mastery made it hard for individuals to analyse the infection. To recognize the infection, Roentgenogram (X-ray) pictures of the individual chest are utilized, yet the pictures look basically the same as those of pneumonia, making it much harder to accurately distinguish the infection. Before, AI was generally used to group pictures in the clinical field. Recent efforts have been made to classify chest X-Ray images by various extraction techniques and classifiers. In recent years, local binary patterns (LBP) [7] have been utilized to group X-ray pictures during function extraction. In image processing and classification, deep learning advances played a main role. For greater classification accuracy, neural networks have been observed. However, large data sets are required, and the accessibility of information is a significant problem. It moreover takes a extensive time to train neural networks that reduce their usability [8]. In order to detect anomalies in Chester images, neural networks are used to detect (CNN). CNN variations were also used in the recent classification of the Covid19 virus [9]. Several algorithms for classifying medical images have been used in the past.

2. Materials And Methods

In fact, deep CNNs perform superior with a huge dataset over a more modest dataset. There are considerable numbers of COVID-19 patients worldwide, although there is a small and dispersed number of openly accessible chest X-ray photos online. Hence, a sensibly enormous dataset of Coronavirus infected chest Roentgenogram (X-ray) pictures [10] was described in this study, although normal pneumonia pictures will soon be made publicly accessible [11] and used in this study.

A. Dataset Collection

Chest Roentgenogram (X-Ray) examination is a troublesome endeavor in a wellbeing discipline to take into consideration. There are currently thousands of readily accessible X-Ray datasets, and only a few thousand images contain these data sets. Based on Chest X-ray images using Artificial Intelligence (AI)[11], the Radiology Society of North America (RSNA) has held a phenomenon detection challenge back in 2018. Participants are required to develop an algorithm to detect and identify pneumonia via X-ray chest images. In publicly available sources, positive and suspected COVID-19 pictures were acquired [10]. Chest X-ray images of normal individuals and those affected with pneumonia were taken from Kaggle and utilized as covid-19 negative dataset.

Once the data has been collected in the raw format, it has to be processed by removing all unwanted information from it using various data preprocessing methods [12], [13].

B. Proposed CNN Architecture

The Convolution Neural Network is made of many minor units known in the layered architecture as nodes/neurons. These nodes incorporate loads that are refreshed by enhancing procedures like backpropagation during model preparing, and so on. Each Convolution Neural Network replica is comprised of the convolutional or feature extraction part and the characterization segment. The segments and construction of the VGG-16 Convolution Neural Network model applied are portrayed in Chart I. Flowchart representing the identification of covid-19 by the method proposed and CNN architecture is shown in fig1 and fig2 respectively.

1) Convolutional Layer: It gives a fundamental segment to convolutionary neural organizations. This layer utilizes a channel of a fixed size to separate a few functions. For this situation, there are 6 convolutions with the size of 32, 64, 64, 128, 128 and 128 channels in the CNN model. The image inspection will take place via step-by-step filter transfers. Each layer uses 3x3 and one stride 2D convolutional filters.

2) Batch Normalization: The CNN model's learning rate is improved and that image of the input is standardized. In Convolution Neural Network (CNN) replica batch normalization is applied after each convolutionary layer.

3) Pooling Layer: It is a way which shows down from the convolution layer the collected feature map. Max pooling, average pooling and a max pooling with a pooling filter size of 2*2 are usually used in all convolutional layers.

4) Activation: Activation function represents a nonlinear processing of input at every end of the layer. ReLU is an activation feature commonly used on each end of the layer, and there are two nodes used in the final layer with an activation function.

5) Dropout: A method for easing overfitting model. Some layer nodes using the drop-out method are selected at times randomly to inactivate. This means that the model does not get to know the data excessively. The decrease of 0.5 has been used in dense layers of the classification [14] model.

6) Dense Layers: As contribution to dense layer, the yield of the convolutionary layer has been additionally straightened. The overlay chore is to separate features and to classify images, the part of the dense layer is. CNN architecture comprises of two dense layers with 512 hubs and two completing layer hubs.

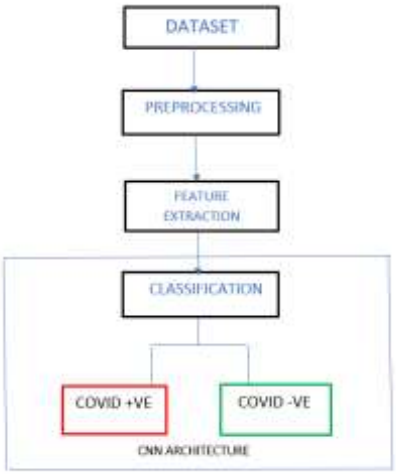


Fig.1 Flowchart representing the identification of covid-19 by the method proposed.

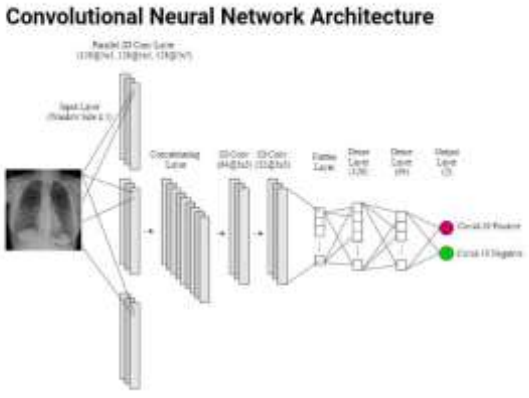


Fig2. CNN Architecture

Chart I. VGG-16 CNN MODEL ARCHITECTURE

Layer (type)	Output Shape	Param #
model (Functional)	(None, 100, 100, 384)	11008
conv2d_3 (Conv2D)	(None, 98, 98, 64)	221248
activation (Activation)	(None, 98, 98, 64)	0
max_pooling2d (MaxPooling2D)	(None, 49, 49, 64)	0
conv2d_4 (Conv2D)	(None, 47, 47, 32)	18464
activation_1 (Activation)	(None, 47, 47, 32)	0
max_pooling2d_1 (MaxPooling2	(None, 23, 23, 32)	0
flatten (Flatten)	(None, 16928)	0
dropout (Dropout)	(None, 16928)	0
dense (Dense)	(None, 128)	2166912
dropout_1 (Dropout)	(None, 128)	0
dense_1 (Dense)	(None, 64)	8256
dropout_2 (Dropout)	(None, 64)	0
dense_2 (Dense)	(None, 2)	130

Total params: 2,426,018
Trainable params: 2,426,018
Non-trainable params: 0

3. Results and Discussion

Python was used as software development language for the training and testing of the 64-bit Windows 10 operating system. For implementation of the model, the machine with intel i3, 12GB RAM is used. TensorFlow is used for training and testing the model on the backdrop of keras. Data aggregation to increment the image dataset was also incorporated. Methods used are photo flipping, image rotation and zoom range. Figure 5 shows illustration of validation-accuracy versus accuracy and loss of validation versus training- loss. This graph depicts the overall performance of a model that is used to extract features from an image during a plot modelling procedure. During training phase, the trained model achieved an accuracy rate of 92.77 percent.

(a)

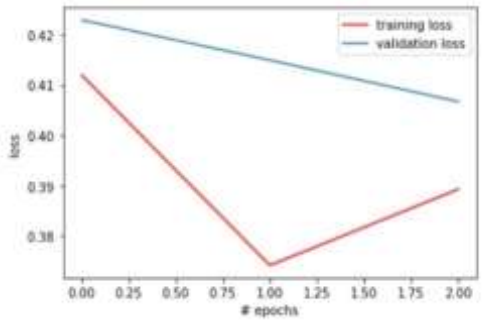
(b)

Fig3. Chest X-Ray images showing presence of COVID-19.

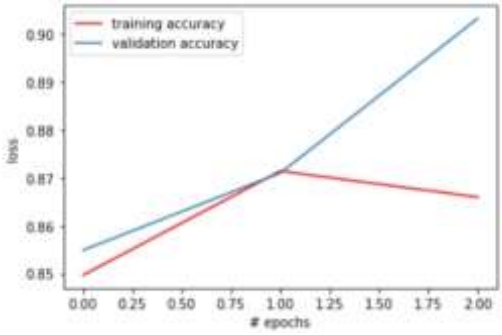
(a)

(b)

Fig4. Chest X-Ray images of absence of COVID19



(a)



(b)

Fig5. Training performance and end results using VGG16 model.

4. Conclusion

To try not to spread the infection in various people, early forecast of COVID-19 patients is significant. We proposed a deep learning approach in this study, utilizing chest X-beam pictures got from patients of COVID-19, normal and pneumonia. We accomplished 92.77% accuracy for the recognition of COVID-19 by utilizing the prepared VGG-16 model. Because of its high overall performance, it is widely believed that medical doctors are able to take decisions in scientific practice. This task will give bits of knowledge into how profound learning techniques can be applied to meet COVID-19 at a beginning phase. COVID-19 has now become a peril to the world's wellbeing framework,and there have already been millions of deaths. Deaths were triggered by breathing malfunction, which results in other organs breakdown. As a large number of outdoor or emergency patients have limited time for

their doctor and computer-aided analysis are able to save lives through early screening and appropriate consideration. This model is very effective in predicting the accuracy of COVID-19, tuition itself effectively from a relatively small photography set. We accept that this computerized analytic apparatus can improve diagnostic cases with COVID-19 significantly. This could be of great use in pandemics when disease burdens and the need for preventive action do not correspond to resource availability.

Future studies can improve the performance of CNN architecture with hyperparameters adjusted and learning combinations transferred. The better COVID-19 model could also be achieved by improving a complex network structure. We also expect that larger COVID-19 patient datasets will be made available in the future and that the precise use of our proposed network will further increase.

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