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# Covid-19 Detection using Deep Learning

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**ABSTRACT—**

The COVID-19 pandemic has created a global health crisis, and accurate and efficient detection of the virus is essential to manage its spread. Deep learning techniques have shown promising results in the detection of COVID-19 using X-ray images. In this study, we present the detection of COVID-19 using deep learning algorithms applied to X-ray images. The proposed model uses a Convolutional Neural Network (CNN) to automatically classify X-ray images as COVID-19, NON-COVID, or Normal. The CNN has been used for the detection of COVID-19. The dataset used for the study includes X-ray images of patients with COVID-19, as well as X-ray images of patients with other respiratory diseases and healthy individual. The results of the study demonstrate the potential of deep learning CNN algorithm were used for the detection of COVID-19 using X-ray images, which can aid in the rapid diagnosis and treatment of patients with COVID-19. The simple web application were created using Django framework and demonstrated to detect the COVID-19 using chest X-rays.

***Keywords—COVID-19, Chest X-ray, Convolutional Neural Network (CNN).***

## 1. Introduction

The COVID-19 virus spreads rapidly during the first months of the pandemic. This propose that each infected person spread the disease to more than one of the people on average. As a result, the number of people infected with COVID-19 has deceased from a few hundred in January 2020 to over 43 million in November 2020, spreading worldwide. Fever and cough were the most common core symptoms in the majority of patients, although some patients may not notice any symptoms in the early stages. Cough medicines, analgesics, antipyretics, and antibiotics are guided to patients based on symptoms rather than the diseased organism. COVID-19 remains a deadly disease due to the lack of early detection technologies worldwide and pre-existing medical conditions such as cancer, chronic liver, lung and kidney disease, and diabetes. Although RT-PCR diagnostic technology is available in most parts of the world, developing countries still cannot afford to rapidly test all of their populations.

Artificial intelligence has proven its efficiency and good performance in the problem of automatic image classification by various machine learning methods and is currently used to automate the diagnosis of various diseases. Deep learning, a collection of machine learning techniques primarily focused on automatic image feature extraction and classification, holds great promise for various applications, especially in healthcare. So far, we have used various AI techniques to identify optimal networks for radiology and medical imaging. Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN) are two well-known deep learning bases that are widely used and often generated in medical research fields. Image classification, localization, and segmentation using CNNs have shown impressive results in medical image processing. World Health Organisation (WHO) recommends using RT-PCR as the primary diagnostic method for detecting COVID-19. The high infection rate of COVID-19 has resulted in a large influx of patients into hospitals in a short period of time, placing a heavy burden on imaging physicians and often lacking physicians to combat the disease. Deep learning techniques have come a long way in recent years, mainly due to increasing computational power and increasing amounts of available data, as well as improvements in deep learning models. Train it on a large amount of sample data to eventually improve its classification or prediction accuracy.

A chest X-ray or chest CT scan is also widely used, but should only be preferred if RT-PCR testing is not available in a timely manner. Furthermore, the high number of false negatives has significantly delayed the detection of COVID-19 positive patients. In addition, RT-PCR false-negative cases show positive results on chest radiographs. Due to its widespread use, X-ray imaging has played an important role in many medical and epidemiological settings. However, previous studies found significant discrepancies in chest radiographs obtained from patients with COVID-19. In this study, the combination of algorithms in deep learning architecture was proposed to detect COVID-19 disease. Using image processing methods such as enhancement, normalization, and data augmentation, the proposed model not only avoid overfitting, but also demonstrate the highest accuracy.

## 2. Methodology

This section describes the CNN model which includes the phases used for covid-19 detection.

***a) Datasets***

The collected Chest X-ray images dataset contains 21,713 X-ray images divided into 17,371 images for preparing (80%) and 4,342 (20%) for testing. There are three classes were displayed here: Covid-19, Non-Covid and Normal images. In 21,713 images, there are 7,658 of Covid-19, 7,258 of Non covid and 6,849 Normal images. The X-ray pictures were collected from the Kaggle site and bringing in the Keras libraries.

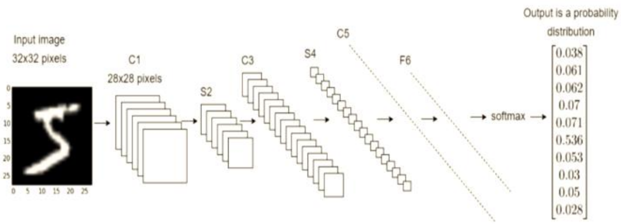
(a) COVID-19 (b) NONCOVID-19 (c) NORMAL

***b) Model***

- Convolutional Neural Network

The objectives of the work is to obtain good classification results using coupled transfer learning models. The study was conducted to select a suitable CNN-based deep learning model for investigating COVID-19 image detection. In deep learning, a convolutional neural network (CNN) is a class of artificial neural network most commonly applied to analyse visual imagery. CNNs use a mathematical operation called convolution in place of general matrix multiplication in at least one of their layers. They are specifically designed to process pixel data and are used in image recognition and processing. They have applications in image and video recognition, recommender systems, image classification, image segmentation, medical image analysis, natural language processing ,brain–computer interfaces, and financial time series. 13 CNNs are regularized versions of multilayer perceptrons. Multilayer perceptrons are usually fully connected networks, that is, each neuron in one layer is connected to all neurons in the next layer. The ”full connectivity” of these networks make them prone to overfitting data. Typical ways of regularization, or preventing overfitting, include: penalizing parameters during training (such as weight decay) or trimming connectivity (skipped connections, dropout, etc.)

Developing robust datasets also increases the probability that CNNs will learn the generalized principles that characterize a given dataset rather than the biases of a poorly-populated set. CNNs take a different approach towards regularization: they take advantage of the hierarchical pattern in data and assemble patterns of increasing complexity using smaller and simpler patterns embossed in their filters. CNNs utilize the hierarchical structure of the data they are processing. Instead of trying to process the entire image or input at once, CNNs break it down into smaller, simpler features, which are represented by filters. These filters are applied to different regions of the input to extract the relevant information. As the network progresses through the layers, these features are combined and assembled into more complex patterns, allowing the network to learn increasingly abstract representations of the input. This hierarchical approach allows CNNs to efficiently learn complex patterns in data, while minimizing the risk of overfitting. Therefore, on a scale of connectivity and complexity, CNNs are on the lower extreme.




***c) Tensorflow and Keras***

As shown in Figure 4, it is an artificial neural network with three or more layers. It has a single input, a single output, and many invisible layers. To use transfer learning for chest x-ray classification, we used the TensorFlow library to load the models onto our local machine, retrain it on the chest x-ray dataset, and then classify it into one of three categories. generated a new image of Normal, non-covid, and COVID-19. A deep learning framework established by Google that can control all neurons (nodes) in the system and has libraries suitable for image processing. You can change the weights of your neural network to improve its performance.

***d) Proposed Architecture***

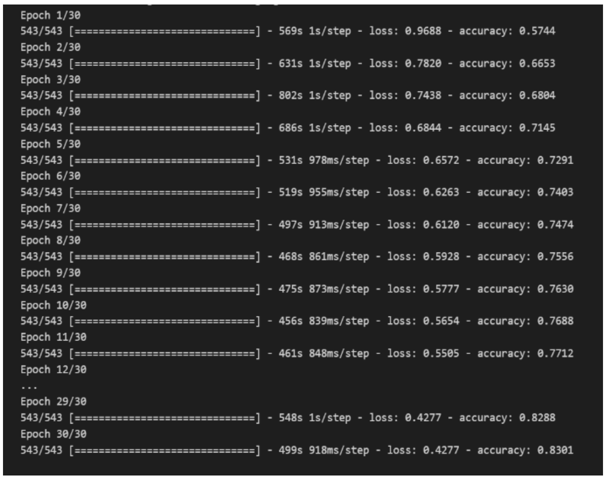
The Convolutional Neural Network is a gradual process and extract various features of the input. Each kernel is responsible for generating an output function. Low-level image features such as edges, lines, and corners are determined by the lower layers, and high-level features are extracted from the upper layers. Apply pooling to make the features obtained from the convolution robust to noise. There are typically two types of pooling layers: average pooling and max pooling. This is basically a dimensionality reduction or feature extraction step. Simple example of max pooling and average pooling

In this study, we had used the CNN model , to classify COVID-19 chest radiographs into normal, non-COVID, and COVID-19 classes. In addition, we applied a transfer learning technique realized using Image data to overcome the scarcity of data and training time. Schematic of a conventional CNN model for predicting COVID-19 patients, NON-COVID and Normal. Chest X-rays are taken as input, the model is applied, convolution, pooling, SoftMax and fully connected processes are performed. After completing these tasks, you will be sorted according to different training modules and finally into normal, non-COVID-19, and COVID-19 classes.

***e) Fit the CNN model***

In the field of deep learning, the popular Adam algorithm is used because it gives good results quickly. This is an optimization algorithm that updates weights in an iterative network based on training data instead of classical random gradient descent.

The optimizer called Adam is an efficient variant of gradient descent and typically does not require manual tuning of the learning rate. Throughout training, the optimizer uses the gradient of the loss to try to reduce ("optimize") the error in the model output by adjusting the parameters. Apply fitting to the training set (steps_per_epoch:543, no. epoch: 10, Validation data: test-set, call backs= [early stop]).



```
Epoch 1/30
543/543 [==============================] - 569s 1s/step - loss: 0.9688 - accuracy: 0.5744
Epoch 2/30
543/543 [==============================] - 631s 1s/step - loss: 0.7820 - accuracy: 0.6653
Epoch 3/30
543/543 [==============================] - 802s 1s/step - loss: 0.7438 - accuracy: 0.6804
Epoch 4/30
543/543 [==============================] - 686s 1s/step - loss: 0.6844 - accuracy: 0.7145
Epoch 5/30
543/543 [==============================] - 531s 978ms/step - loss: 0.6572 - accuracy: 0.7291
Epoch 6/30
543/543 [==============================] - 519s 955ms/step - loss: 0.6263 - accuracy: 0.7403
Epoch 7/30
543/543 [==============================] - 497s 913ms/step - loss: 0.6120 - accuracy: 0.7474
Epoch 8/30
543/543 [==============================] - 468s 861ms/step - loss: 0.5928 - accuracy: 0.7556
Epoch 9/30
543/543 [==============================] - 475s 873ms/step - loss: 0.5777 - accuracy: 0.7630
Epoch 10/30
543/543 [==============================] - 456s 839ms/step - loss: 0.5654 - accuracy: 0.7688
Epoch 11/30
543/543 [==============================] - 461s 848ms/step - loss: 0.5505 - accuracy: 0.7712
Epoch 12/30
...
Epoch 29/30
543/543 [==============================] - 548s 1s/step - loss: 0.4277 - accuracy: 0.8288
Epoch 30/30
543/543 [==============================] - 499s 918ms/step - loss: 0.4277 - accuracy: 0.8301
```

## 3. Result and Discussion

In the experiment, a dataset of 21,713 chest X-ray images was used for training and testing, with 17,371 images for training (80%) and 4,342 images for testing (20%). rice field. The model is a set of 7,658 x-rays of people, 7,258 with Covid-19 and 6,849 non-covid, and divided into Covid-19 and non-covid was trained on a set of 1,000 chest radiographs. To improve the learning process, the complete data set should be passed multiple times through the same neural network. Then update the CNN model weights using 30 epoch. The results showed 83% accuracy and 42% loss. Experience has shown that certain models can more accurately identify COVID-19 in human samples and enable patient identification as the training sample increases.

We had created the web application using Django framework and detection whether the X-ray image is covid, non-covid or normal. Here is the demonstration for detection covid-19.

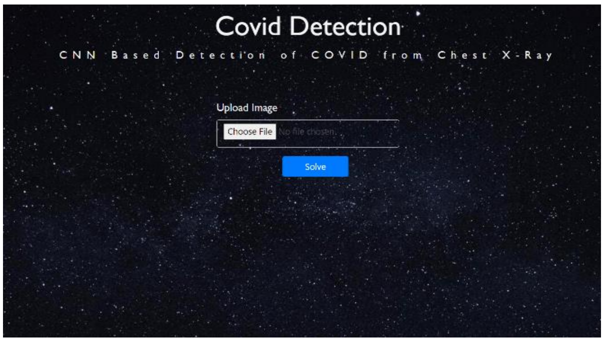


*Fig Covid-19 Detection application*

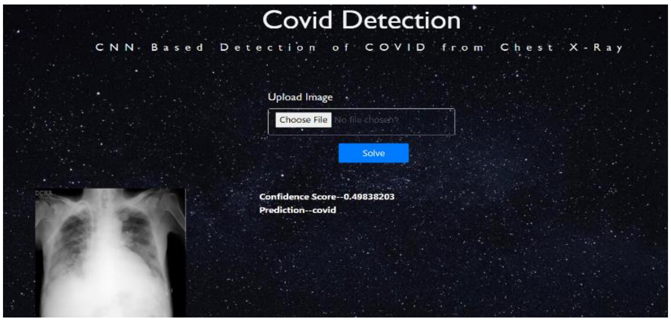



*Fig Covid-19 Detection output*

## 4. Conclusion and future works

In summary, the results of this unique study demonstrate the potential role of highly accurate artificial intelligence algorithms in rapidly identifying patients, helping combat the current Covid-19 epidemic. may be useful and effective on The proposed CNN model has the highest accuracy score by expert thoracic radiologists and represents a highly effective research tool for rapid diagnosis of many infectious diseases such as the COVID-19 epidemic. so it is almost certain that it is possible. Neither does radiologist referral yet require a physical examination.

We recommend that future research address other issues such as outbreak escalation and explore different approaches to convolutional neural networks, such as deep learning models and improved interpretations of his CNN model. .

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