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Research Paper

Finding of COVID-19 from Human X- Ray Images using Deep Learning Approach

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ABSTRACT: *The detection of severe acute respiratory syndrome coronavirus 2 (SARS CoV-2), which is responsible for coronavirus disease 2019 (COVID-19), using chest X-ray images has life-saving importance for both patients and doctors. Early prediction of patient severity might assist save hospital resources and reduce the number of patients who die indefinitely. Currently, X-ray pictures are utilized to detect COVID-19 patients as early signs. In addition, in countries that are unable to purchase laboratory kits for testing, this becomes even more vital. In this study, we aimed to present the use of deep learning for the high-accuracy detection of COVID-19 using chest X-ray images.*

KEYWORDS: *COVID-19 detection, Chest x-rays, Deep learning*

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I. INTRODUCTION

The COVID-19 is a deadly disease caused by the newly recognized coronavirus. In December 2019, Severe Acute Respiratory Syndrome Coronavirus (SARS-COV-2) infected the human body for the first time, and it can spread principally among humans through the droplets formed by the infected persons when they speak, cough or sneeze. As the droplets are too heavy to travel far, they cannot spread person-to-person without coming in close contact. Although the exact time is not yet known, a new study has estimated that the COVID-19 can be viable in the air for up to 3 hours, on copper for 4 hours and up to 72 hours on plastic and stainless steel. However, the exact answers to these questions are still not agreed upon by the general health research community and currently under investigation. COVID-19 attacks the lung and damages the tissues of an infected person. At the early-stage, some people may not find any symptoms where most of the people had fever and cough as the core symptoms. Other secondary symptoms could be body aches, sore throat, and a headache could be all possible.

At present, COVID-19 disease is increasing daily due to the lack of quick detection methods. All over the world, a huge number of people died of this disease in 2020. The respiratory tract and lungs are the media where the virus can spread easily. As a result, inflammation occurs, and air sacs can be filled with fluid and discharge. The process is responsible for creating an obstacle in oxygen intake. Quick and accurate detection of the virus is a major challenge for doctors and health professionals around the world in order to reduce the death rate caused by this virus. The novel coronavirus disease came first as a throat infection, and suddenly people faced difficulty in breathing. The covid-19 illness is a hidden enemy where no one is capable of fighting. Infected patients of Covid-19 are required to be in isolation, do proper screening, and take adequate protection with prevention to protect healthy people. This infection is following a chain process that transfers from one person to another after coming in contact with covid-19 infected persons. Hospital staff, nurses, doctors, and clinical facilities play an essential role in the diagnosis of this epidemic. Many more strategies have been applied to reduce the impact of Covid-19. Medical imaging is also a method of analyzing and predicting the effects of covid-19 on the human body. In this, healthy people and Covid-19 infected patients can be analyzed in parallel with the help of CT (Computerized Tomography) images and chest X-ray images.

II. LITERATURE SURVEY

Authors Safynaz Abdel-Sattah Sayed, Abeer Mohamed Elkorand Sabah Sayed Mohammad was proposed a system that is "Applying Different Machine Learning Techniques for Prediction of Covid-19 Severity", in IEEE Access, vol. 9, pp. 135697- 135707,2021. The problem that was addressed in this project is fast and accurate Artificial Intelligence techniques are needed to assist doctors in their decisions to predict the severity and mortality risk of a patient. A deep pre-trained prediction model named CheXNet was built. Also, hybrid handcrafted techniques were applied to extract features, two different methods namely Principal Component Analysis (PCA) and Recursive Feature Elimination (RFE) were integrated to select the most important features [1].

Hierarchical fracture classification of proximal femur X-ray images using a multistage deep learning approach was developed by Leonardo Tanzi, Enrico Vezzetti, Rodrigo Moreno, Alessandro Aprato, Andrea Audisio, Alessandro Masse Applied Intelligence 51(3), 1690-1700, 2021.Covid-19 is a rapidly spreading viral disease that infects not only humans, but animals are also infected because of this disease. The daily life of human beings, their health, and the economy of a country are affected due to this deadly viral disease. Covid-19 is a common spreading disease, and till now, not a single country can prepare a vaccine for COVID-19. A clinical study of COVID-19 infected patients has shown that these types of patients are mostly infected from a lung infection after coming in contact with this disease. Chest x-ray (i.e., radiography) and chest CT are a more effective imaging technique for diagnosing lunge related problems. Still, a substantial chest x-ray is a lower cost process in comparison to chest CT. Deep learning is the most successful technique of machine learning, which provides useful analysis to study a large amount of chest x-ray images that can critically impact on screening of Covid-19. In this work, we have taken the PA view of chest x-ray scans for covid-19 affected patients as well as healthy patients. After cleaning up the images and applying data augmentation, we have used deep learning-based CNN models and compared their performance [2].

III. PROPOSED SYSTEM

In this section, we have proposed a model which detects the COVID-19 with the help of Chest X-ray images. The planned model is used to give accurate diagnostics on two different classification models the (i.e., binary and multi-class). We have considered the patients who confirmed with covid-19 pneumonia and were admitted to the hospital; and divided the patients of CT scan into different groups, and features of the image and its distribution were further analyzed and compared for detecting COVID-19 diseases.

In this paper, we proposed a Convolution Neural Network (CNN), which helps in finding the analyses of COVID-19 by using Chest X-ray images. The proposed model shows 98% accuracy.

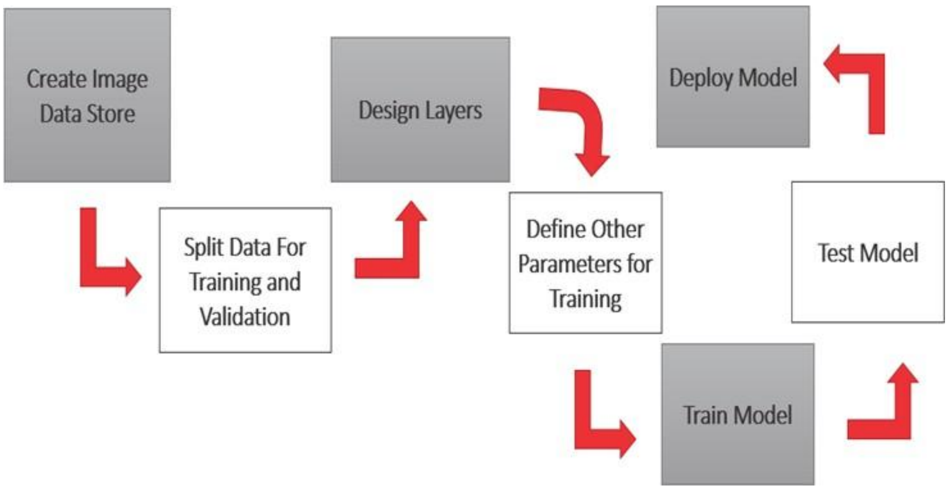

Figure1: Process flow of the proposed system

For this study the AlexNet is used, which employs an 8-layer CNN. This network showed, for the first time, that the features obtained by learning can transcend manually-designed features, breaking the previous paradigm in computer vision. AlexNet consists of eight layers: five convolutional layers, two fully-connected hidden layers, and one fully-connected output layer. It uses the ReLU as its activation function.

IV. WORKING PRINCIPLE

First, we have created an image data store and saved the images in two different sub-folders by class name. In covid sub-folder infected X-ray images will be saved; and in normal sub-folder uninfected X-ray images will be saved. We've split the data for training and testing. To get the accuracy, testing is important.

Next, we modified the CNN network according to our data and defined training parameters, like what will be initial learning rate, maximum number of epochs and batch size, etc. Further, we trained our model and optimized hyper parameters whenever it is required. When the model is trained, we tested the model on testing dataset to check its accuracy.

4.1 ALEXNET CONVOLUTION NEURAL NETWORK

AlexNet is a convolutional neural network that is 8 layers deep. You can load a pretrained version of the network trained on more than a million images from the ImageNet database. The pretrained network can classify images into 1000 object categories, such as keyboard, mouse, pencil, and many animals. As a result, the network has learned rich feature representations for a wide range of images. The network has an image input size of 227-by-227. AlexNet has been trained on over a million images and can classify images into 1000 object categories (such as keyboard, coffee mug, pencil, and many animals). The network has learned rich feature representations for a wide range of images. The network takes an image as input and outputs a label for the object in the image together with the probabilities for each of the object categories.

4.2 The Architecture of AlexNet model

In AlexNet's first layer, the convolution window shape is 11×11. Since most images in ImageNet are more than ten times higher and wider than the MNIST images, objects in ImageNet data tend to occupy more pixels. Consequently, a larger convolution window is needed to capture the object. The convolution window shape in the second layer is reduced to 5×5, followed by 3×3. In addition, after the first, second, and fifth convolutional layers, the network adds maximum pooling layers with a window shape of 3×3 and a stride of 2.

After the last convolutional layer there are two fully-connected layers with 4096 outputs. These two huge fully-connected layers produce model parameters of nearly 1 GB. Due to the limited memory in early GPUs, the original AlexNet used a dual data stream design, so that each of their two GPUs could be responsible for storing and computing only its half of the model. Fortunately, GPU memory is comparatively abundant now, so we rarely need to break up models across GPUs these days.

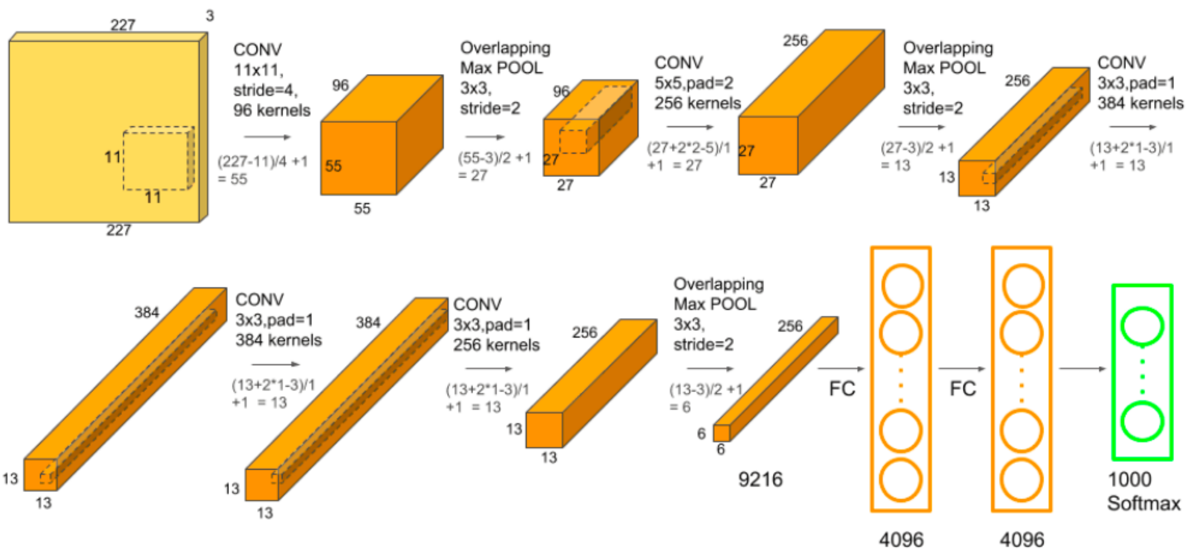

Figure2: The Architecture of AlexNet model

In the first layer, a convolutional window of size 11 × 11 is used. It is because of input size is large, so we need to use a large kernel to capture the object. The convolutional window shape in the next layers is reduced gradually to 5× 5 and 3 × 3, but the number of filters is increased in parallel. The two first and the last convolutional layers are followed by max-pooling layers, where a pooling window of size 3 × 3 and a stride of 2 steps are applied. Hence, the output size is halved throughout these pooling layers.

In this model, the ReLU activation function was applied. Besides, the authors also used some techniques to reduce overfitting phenomena, such as data augmentation and dropout. For more detail, the dropout technique was applied in the two first fully connected layers with a dropping ratio of 50%.

4.3 Image Classification Using Convolutional Neural Network (CNN)

In this software we are using pretrained Convolutional Neural Network (CNN) as a feature extractor for training an image category classifier.

A Convolutional Neural Network (CNN) is a powerful machine learning technique from the field of deep learning. CNNs are trained using large collections of diverse images. From these large collections, CNNs can learn rich feature representations for a wide range of images. These feature representations often outperform hand-crafted features such as histogram of oriented gradients (HOG), Local Binary Pattern (LBP), or SURF. An easy way to leverage the power of CNNs, without investing time and effort into training, is to use a pretrained CNN as a feature extractor.

The CNNs are inspired by visual system of human brain. The idea behind the CNNs thus is to make the computers capable of viewing the world as humans view it. This way CNNs can be used in the fields of image recognition and analysis, image classification, and natural language processing. CNN is a type of deep neural networks which contain the convolutional, max pooling, and nonlinear activation layers. The convolutional layer, considered as a main layer of a CNN, performs the operation called “convolution” that gives CNN its name. Kernels in the convolutional layer are applied to the layer inputs. All the outputs of the convolutional layers are convolved as a feature map. In this study, the Rectified Linear Unit (ReLU) has been used in the activation function with a convolutional layer which is helpful to increase the nonlinearity in input image, as the images are fundamentally nonlinear in nature.

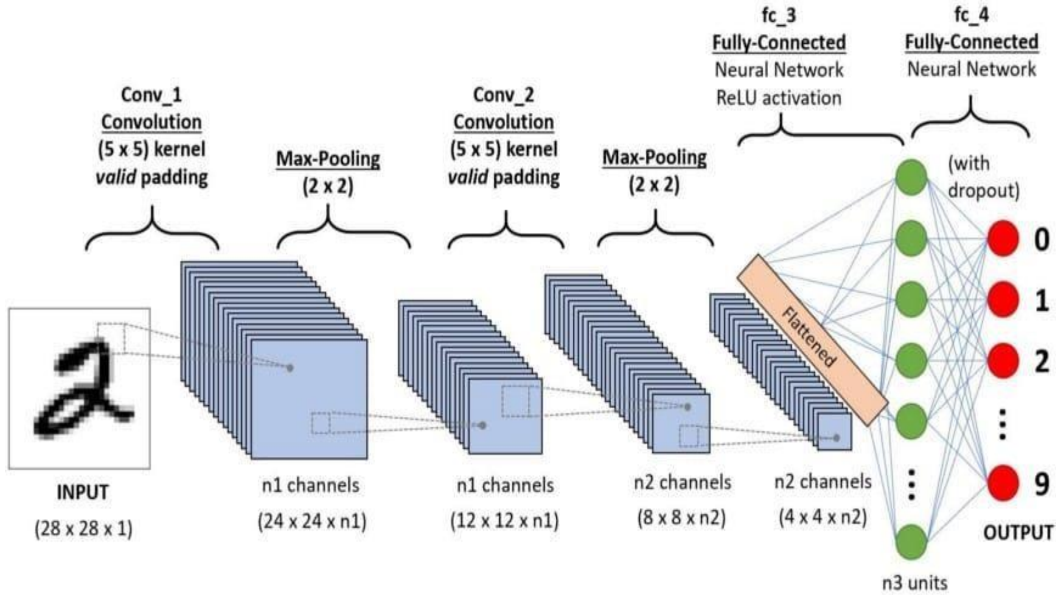

Figure3: Convolutional Neural Network Architecture

V. RESULTS

5.1 Detection

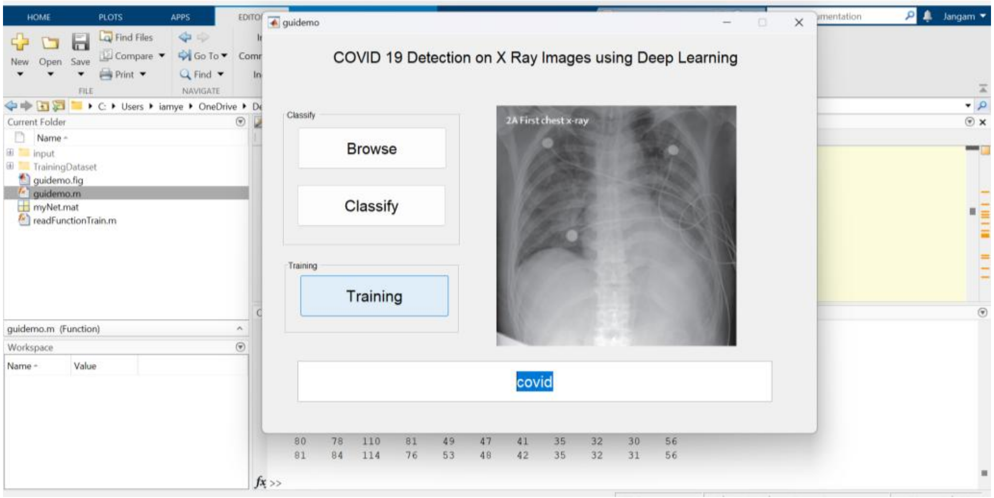

Figure4: Detection of COVID-19 from an X-ray image

5.2 Training of the model

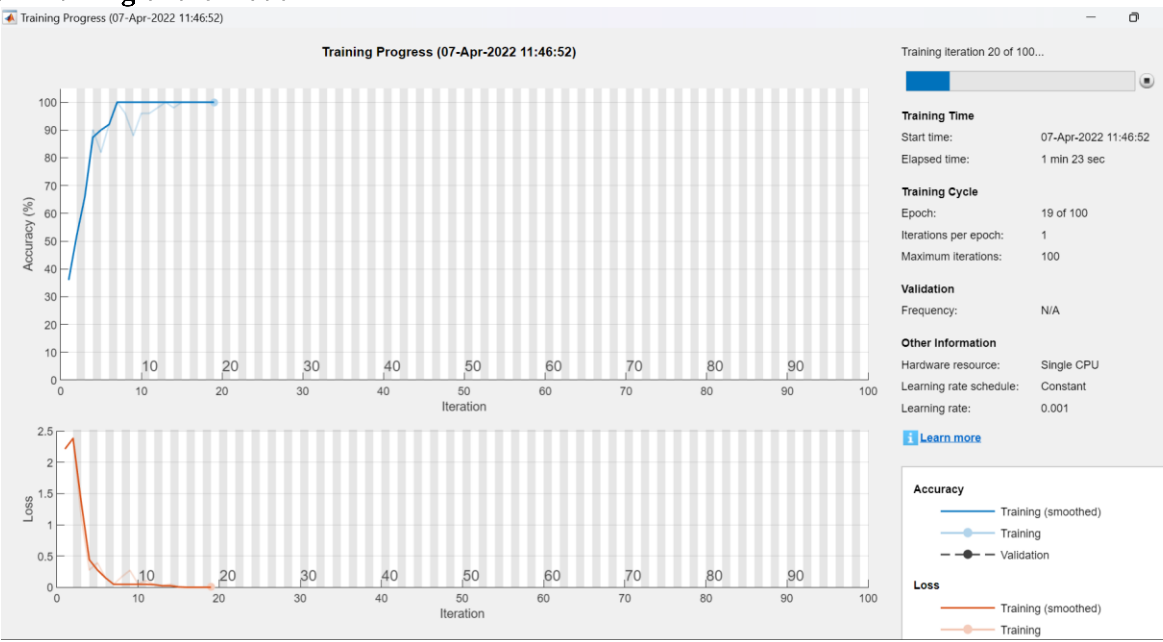

Figure5: Graph showing accuracy and loss while training the model

VI. CONCLUSION

COVID-19 pandemic is a growing manifold daily. With the ever-increasing number of cases, bulk testing of cases swiftly may be required. In this work, we experimented with multiple CNN models in an attempt to classify the Covid-19 affected patients using their chest X-ray scans. Further, we concluded that out of these three models, the AlexNet has the best performance and is suited to be used. We have successfully classified covid-19 scans, and it depicts the possible scope of applying such techniques in the near future to automate diagnosis tasks. The high accuracy obtained may be a cause of concern since it may be a result of overfitting. This can be verified by testing it against new data that is made public shortly. In the future, the large dataset for chest X-rays can be considered to validate our proposed model on it. It is also advised to consult medical professionals for any practical use case of this project. We do not intend to develop a perfect detection mechanism but only research about possible economically feasible ways to combat this disease. Such methods may be pursued for further research to prove their real case implementation.

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