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DIAGNOSIS OF COVID-19 USING DEEP LEARNING TECHNIQUES

Vasupalli Chandini[1], ShaikAlthaf Rahaman[2]

[1]P. G Student, Dept of Computer Science, GITAM School of Science, GITAM (Deemed to be University)

[2]Assistant Professor, Dept of Computer Science, GITAM School of Science, GITAM (Deemed to be University)

Abstract: Early diagnosis of the corona virus disease in 2019(COVID-19) is essential for controlling this pandemic. COVID-19 has been circulating rapidly all over the world. There is no vaccine· accessible for this virus yet. Fast and detailed COVID-19 screening is possible using computed tomography (CT) scan images. The deep learning techniques used in the proposed method is based on a complexity neural network (CNN).We immediate on differentiating the CT scan images of COVID-19 and non-COVID 19 CT using different deep learning techniques. A self-developed model named CTnet-10 was designed for the COVID-19diagnosis, having an accuracy of 82.1%. The VGG-19 proved to be superior with an accuracy of 94.52% as analyse to all other deep learning models. Automatic diagnosis of COVID-19 from the CT scan pictures can be used by the doctors as a brisk and competent method for COVID-19 screening.

Keywords: COVID-19, CNN, CT scan, diagnosis, VGG, CTnet-10.

1. INTRODUCTION

The corona virus infection was first reported in Wuhan, China, and since then it has strongly spread out since January 2020 worldwide. The World Health Organization (WHO) declared the coup from the Corona virus disorder 2019 (COVID-19) to be a public health crisis of international solicitude on the 30th of January, 2020. COVID- 19 is a respiratory ailment caused by the corona virus. The most common indication includes fever, fatigue, and dry cough, loss of appetite, body aches, and mucus. Some non-specific indication may include sore throat, headache, chills with shaking sometimes, loss of smell or taste, running nose, vomiting, or diarrhea . Indication may usually take 5 to 6 days to show after a person comes in contact with the virus .People with mild indication may recover on their own. People suffering from other health conditions such as diabetes or heart problems may suffer from serious indication.

A computed axial tomography scan, or CT scan, generates detailed images of organs, bones, soft tissues and blood vessels. CT images allow medical doctor to identify internal structures and see their shape, size, density and texture. Different from ceremonious X-Rays, CT scan provide a set of slices of a given region of the body without laminate the different body structures. Thus, CT scans give a much more detailed picture of the patient's condition than

the ceremonial X-Rays. This exact information can be used to determine whether there is a medical problem as well as the extent and exact location of the problem. For these reasons, a number of deep learning based methodologies have been recently suggested for COVID-19 screening in CT scans.

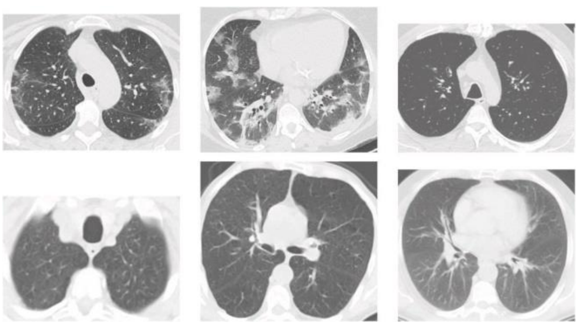

Fig.1.Examples of CT images that are: positive for COVID-19(top) and non-COVID-19(bottom)

In comparison to RT-PCR, the thorax computer tomography (CT) is possibly more reliable, useful, and quicker technology for the categorize and assessment of COVID- 19, in particular to the epidemic region. Almost all hospitals have CT image screening; hence, the thorax CT pictures can be used for the early detection of COVID 19patients.However, COVID-19 classification based on the thorax CT requires a radiology expert, and a lot of beneficial time is lost. In the current scenario, COVID-19 test results take more than 24hr to detect the virus in the

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human body. There is an urgent need to recognize the affliction in the early stage and to put the infected immediately under quarantine because no specific drugsareavailableforCOVID-19.

However, the precision of the diagnosis of COVID-19 by Chest scans strongly depends on experts and Deep learning techniques have been studied as a tool to mechanical and help with the diagnosis current scenario, the COVID-19 test results take more than 24 hours to ascertain the virus in the human body. There is an urgent need to recognize the illness in the early stage and to put the infected immediately under incarcerate because no specific drugs are available for COVID-19.The Chinese government reveal that the diagnosis is evidence of COVID-19 by the real-time polymerase chain reaction (RT-PCR). RT-PCR suffers from high false-negative rates and take advantage of a lot of time. The low susceptibility RT-PCR test is not all right in the present wide spread situation. In some cases, the infected are not possibly grant on time and do not receive suitable treatment. The contaminated can be assigned sometimes as COVID-19 to well people because of a false-negative result

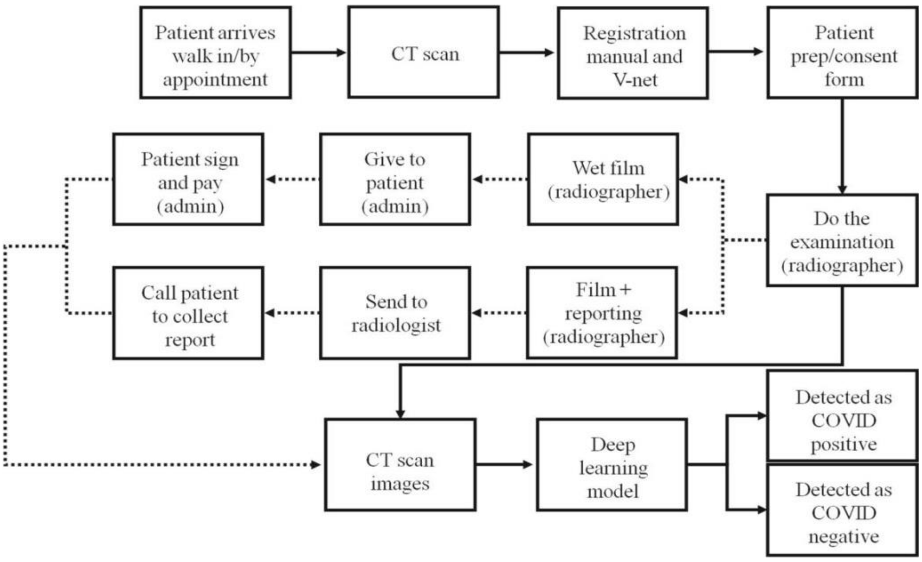
2. LITERATURE SURVEY

Assorted studies and research work have been move out in the field of diagnosis from medical images such as computed tomography (CT) scans using artificial intelligence and deep learning. Dense Net architecture and recurrent neural network layer were incorporated for the analysis of 77 brain CTs by Grew let al.[1]. RAD net demonstrates 81.82% haemorrhage prediction accuracy at the CT level. Three types of deep neural networks (CNN, DNN, and SAE) were designed for lung cancer classification by Song et al [11].The CNN model was found to have better accuracy as compared to the other models. Using deep learning, specifically Convolution neural network (CNN) analysis, Gonzalez et al.[3] could detect and stage chronic obstructive pulmonary disease (COPD) and predict accurate respiratory disease (ARD)events and mortality in smokers. During the outbreak time of COVID-19 CT was found to be usefulfordiagnosingCOVID-19 patients. The key point that can be visualized from the CT scan images for the detection of COVID-19, was ground-glass opacities, consolidation, reticular pattern, and crazy paving pattern[4].A study was done by Zhao et al. [5] to investigate the relation between chest CT findings and the clinical conditions ofCOVID-19pneumonia.Dataon 101 casesofCOVID19 pneumonia were collected from our institutions in Human, China Basic clinical characteristics and detailed imaging features were evaluated and compared. A study on the chest CTs of 121 symptomatic patients infected with corona virus was done by Bernheimer al.[6].The hall marks of COVID-19 infection as seen on the CT scan images were reciprocal and peripheral ground-glass and draw together pulmonary cloudiness. As it is difficult to obtain thedatasetsrelatedtoCOVID-19,an open- sourced data set COVID - CT,whichcontains349COVID-19 CT images from 216 patients and 463 non-COVID-19 CTs was built by Zhao et al.[7]. Using the data set, AI-based diagnosis model for the diagnosis of COVID-19 from the CT images. On a testing set of 157 international patients, an AI-based automated CT image analysis tools for detection, quantification, and tracking of corona virus was designed by Gazes et al. [4].

The common chest CT findings of COVID-19 are multiple ground glass opacity, consolidation, and interlobular sepal thickening in both lungs, which are mostly distributed under A deep learning based software system for automatic COVID-19 detection on chest CT was developed by Zhen et al.[5] using 3D CT volumes to detect COVID-19. A pre trained U Net and a 3D deep neural network was used to predict the probability of COVID-19 infections on a set of 630 CT scans. Of 1014patients, 601 patients tested positive for COVID-19 based on RT-PCR and the results were compared with the chest CT. The sensitivity of chest CT in suggesting COVID-19 was 97 % as shown by Ai et al. [3]. In a series of 51 patients with chest CT and RT-PCR tests performed within 3 days by Fang et al. [2], the sensitivity of CT for COVID-19 infection was 98 %compared to RT-PCR sensitivity of 71 %. An AI system (CAD4COVID-Xray) was trained on24, 678 CXR images including 1,540 used only for validation while training. The radio graphs were independently analysed by six readers and by the AI system. Using RT-PCR test results as the reference standard, the AI system correctly classified CXR images as COVID-19 pneumonia with an AUC of 0.81[6].

3. PROPOSED METHODOLOGY

The workflow diagram of the proposed system is shown in Fig.2.The CT scan procedure starts by either walk- in or getting an appointment. It is then conform by the registry and the filling of the consent form by the patient. The approach for the examination of the CT scan by the radiologist can be done in two ways. The first way comprise of getting a wet film. After making the payment, the wet film is distributed to the patient. In the second way, the wet film captured by the radiographer is given to the radiologist for conditioning a report. The patient then assemble there report .The CT scan images are then fed to the deep learning models for detecting COVID-19. After the examination, the CT scan images can be directly fed to the deep learning model to classify the CT scan images as COVID-19 positive or COVID-19negative.



Fig–2 workflow diagram of the system

In Fig.2 Work flow diagram of the proposed system. The mechanism of getting a CT scan starts by either walk-in or getting an appointment. It is conform by the registration and the filling of the prep or consent form by the patient. The actual procedure of getting a CT scan by the radiographer starts in two ways: one being the wet film and the other film and getting a evaluation. The evaluations are then collected by the patients and the CT scan images can be fed to the deep learning models. After the examination, the CT scan images can be straight fed to the deep learning model to organize the CT scan images as COVID-19 positive or COVID-19negative.

4. DATASET

The COVID-19 CT dataset consisted of the images of patientsthathadtestedpositiveforCOVID-19and the subsequent was also confirmed by the RT-PCR method. From total of 738CT scan images,349 imagesfrom216 patients were confirmed to have COVID-19 whereas 387images were of the non-COVID-19 patients [21]. These images were split into a training set,validationset,and test set with asplitof 80%, 10%,and10%respectively

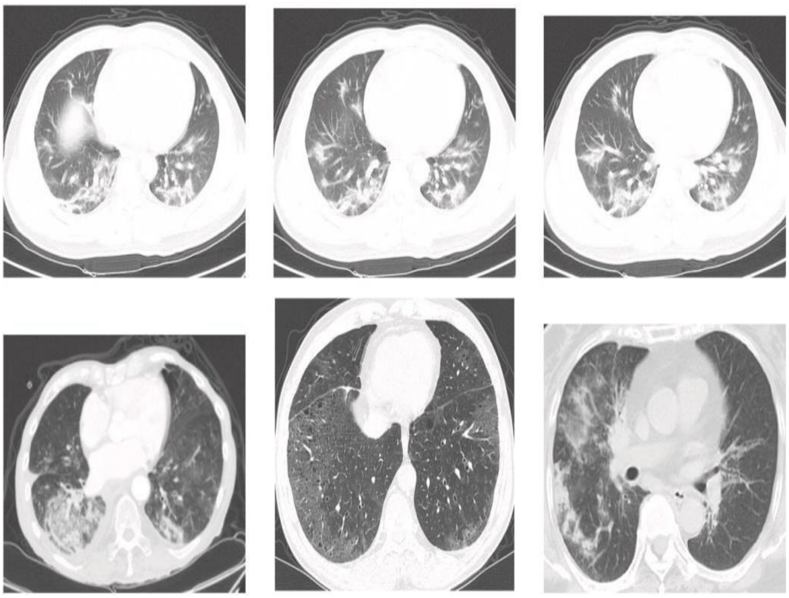


Fig-3 Examples of CT images

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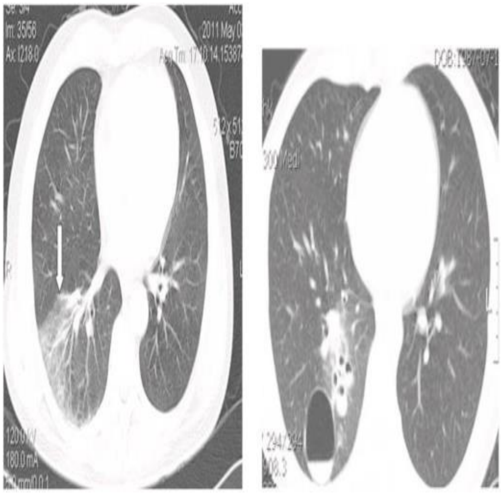

Fig-4 Example of images with textual information

5. PREPROCESSING

The aspiration of pre-processing is an better of the image data that suppresses unwilling distortions or enhances some image features main for further processing, although geometric transformations of images (e.g., revolution, scaling, and translation) are indexed among pre-processing methods here since parallel techniques are used. Data Pre-processing is a technique that is used to transform the raw data into a clean data set. In other words, whenever the data is assemble from different inception, it is collected in raw design which is not feasible for the analysis.

1) Training the model(CNN)

Testing and Validation: After successful training, test results are compared with other existing algorithms in terms of accuracy in prediction.

2) Deep Learning

Deep Learning is one of the methods to overcome the challenges of feature Extraction .Deep learning is an artificial intelligence (AI) function that imitates the workings of the human brain in processing data and creating patterns for use in decision making .Also known as deep neural learning order neural network. In deep learning, each level learns to modify its input data into a minimal more abstract and combine representation. In an image recognition application, the basic in put may be a matrix of element; the first representational layer may abstract the element and encrypt edges; the second layer may compose and encrypt arrangements of edges; the third layer may encrypt. a nose and eyes; and the fourth layer may recognize that the image contains a face. Importantly, a deep learning process can learn which features to supreme place in which level on its own. (Of course, this does not completely remove the need for hand-tuning; for example, varying numbers of layers and layer sizes can provide different degrees of abstraction.)

6. IMPLEMENTATION OF ALGORITHM

For the VGG-19 model, the image phase used were 224x224x3, and the output was a number between 0 and 1. For this case, less than 0.5 corresponds to COVID-19 approving and greater than or same to 0.5 implies COVID-19 negative. As mentioned above, we used VGG- 19 architecture with pre-trained weights of image net. It is a 24- surface model (as shown in Fig. 4)which consists a total of 5 Convolution blocks, 3 max poollayers,and3 FC layers, but we did a fine-tuning by using pre-trained weights for all Convolution blocks, removing the last two fully connected(FC) layer and then adding 2FClayer with 4096 neurons. Dropout was used with each of these layers for regularization with a rate of 0.3.The final binary classification layer of single-neuron governed by using moid activation was added .The model was compiled with A DAM optimization with the default learning rate; the loss function used was binary cross-entropy. The model was trained on a batch size of 32 and Early Stopping was used to prevent over fitting. First, it was trained on 30 epochs without Early Stopping, and then on 20epochswithEarlyStopping, the model stopped at epoch no. 10.

The input images were fed to the visual geometry group- 16 (VGG-16) models with a dimension of 150x150x3. The model consists of 19 layers, having 5 Convolution blocks. Each block consists of two or three Convolution layers

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and 5 max-pooling layers, finally ending with 2 fully connected (FC) and a soft max layer. We replaced the soft max layer with the sigmoid layer for binary classification purposes. The model was trained with root mean square propagation (RMSPROP) and a learning rate of (2e−5) for 30 epochs

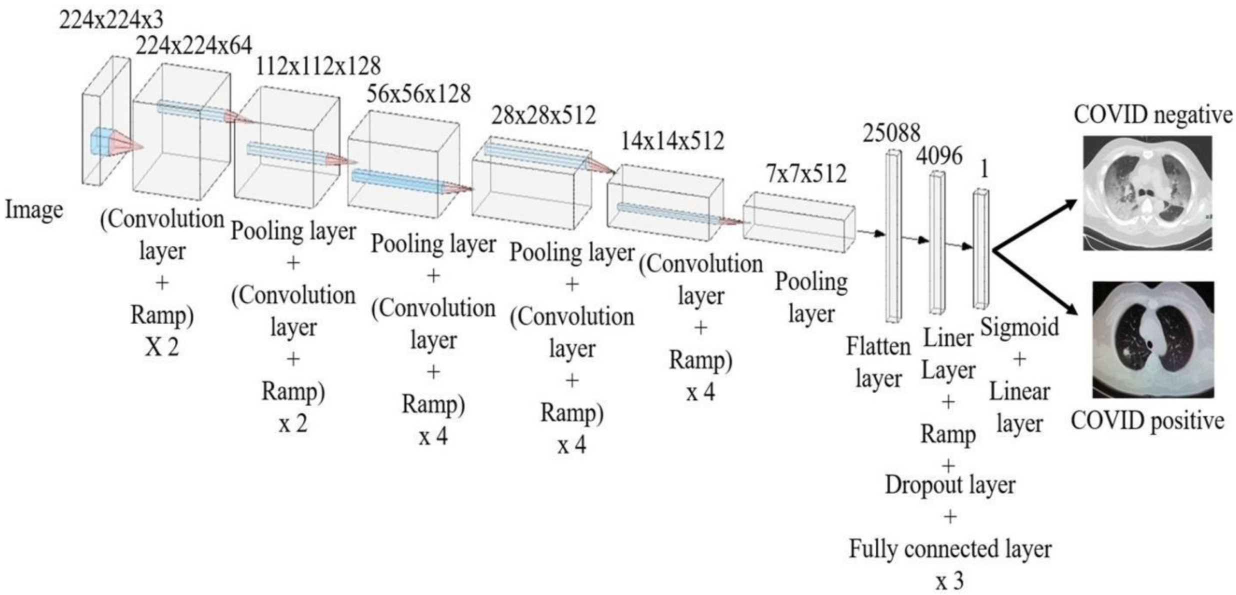
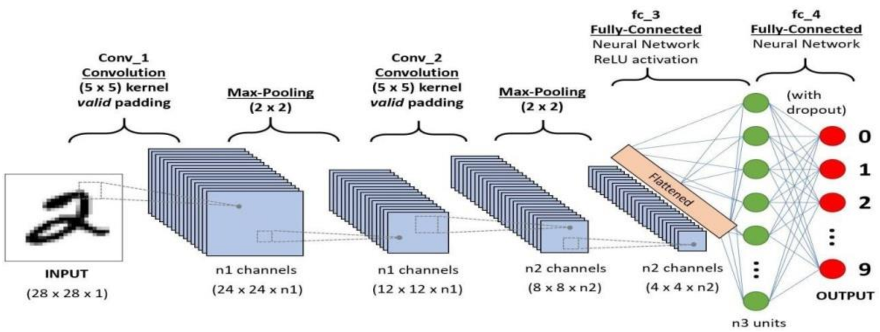


Fig. 5 Configuration of the model of VGG-19

The ideal was fed with an input image of size 224x224x3. There are a total of 5 Convolution blocks. It passes through one of the Convolution layers and a ramp of dimension224x224x64.Then it passes through a next pooling and Convolution layer of dimension 112x112x 128. Then it again passes through two dividing layers of dimensions 56×56×128, 28×28×512 respectively. This is extra passed through the straight layer of dimensions 14x14x512, and a pooling layer of 7x7x512. It is then departed through 25088 neurons of the flattened layer, which is in sequence passed through an FC layer of 4096 neurons, in which the quit layer was used in each of these. After passing it through a single neuron sigmoid and linear, the CTscanimagesareclassifiedasCOVID-19positiveornegative

7. ARCHITECTURE

In1998, the LeNet-5 architecture was launch in are search paper titled "Gradient- Based Learning Applied to Document Recognition" by YannLeCun, LeonBottou, YoshuaBengi, and Patrick Haffner. It is one of the original and most basic CNN architecture. It consists of 7 layers. he first layer consists of an input image with dimensions of32×32. It is convolved with 6 filters of size 5×5 ensuing in dimension of 28x28x6. The second layer is a Pooling operation which filters size 2×2 and stride of 2.Hence the ensuing image dimension will be14x14x6.Similarly, the third layer also involves in a convolution operation with 16 filters of size 5×5 followed by a fourth pooling layer with similar filter size of 2×2 and stride of 2 .Thus, the ensuing image dimension will be reduced to 5x5x16 Once the image dimension is reduced, the fifth layer is a fully connected spiral layer with 120 filters each of size 5×5. In this layer, each of the 120 units in this layer will be associated to the 400 (5x5x16) units from the previous layers. The sixth layer is also a fully connected layer with 84 units. The final seventh layer will be a Soft max output layer with 'n' possible classes depending upon the number of classes in the data set..



Fig–6 Architecture of CNN

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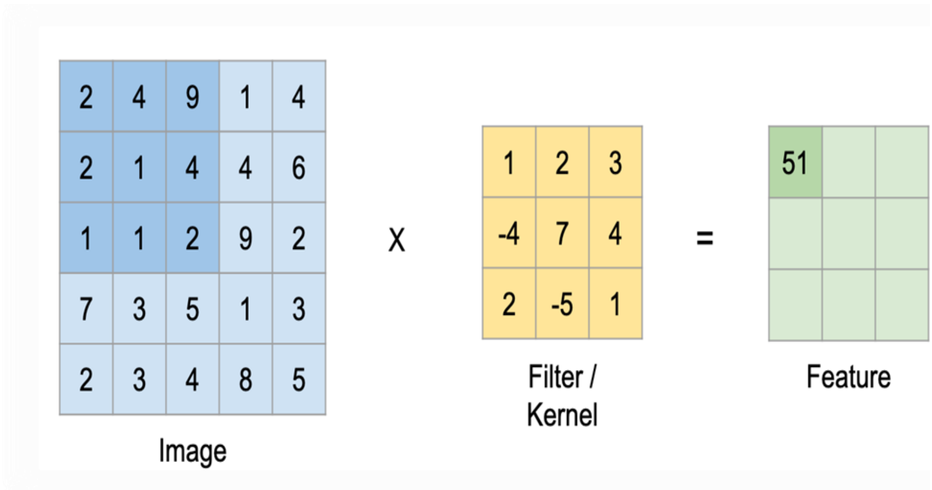
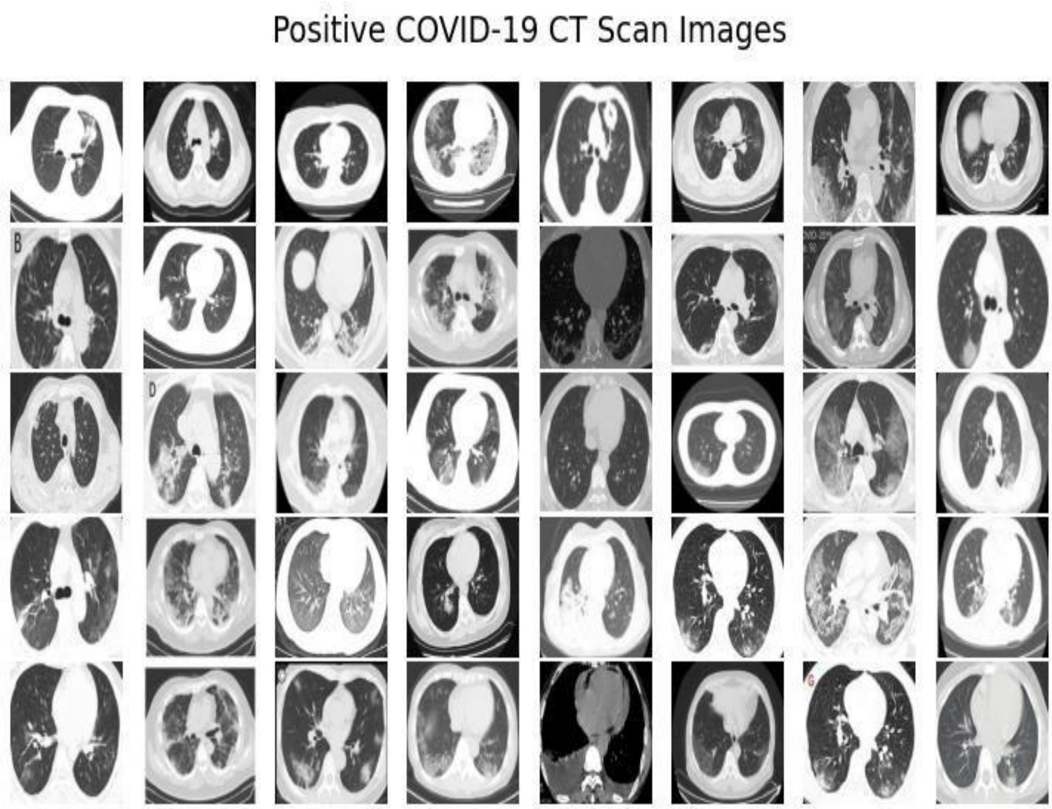
First, there a meager things to learn from layer 1 that is paces and padding, we will see each of them in brief with examples Let us suppose this in the input matrix of 5×5 and a filter of matrix 3X3, for those who don't know what a refiner. is a set of weights in a matrix applied on an image or a matrix to obtain the demand features, please search on spiral if this is your first time!

Note: We always take the sum or average of all the values while doing a spiral.

A filter can be of any intensity, if a filter is having a intensity d it can go to a intensity of d layers and spiral i.e. value all the (weights x inputs) of d layers.



8. RESULTS



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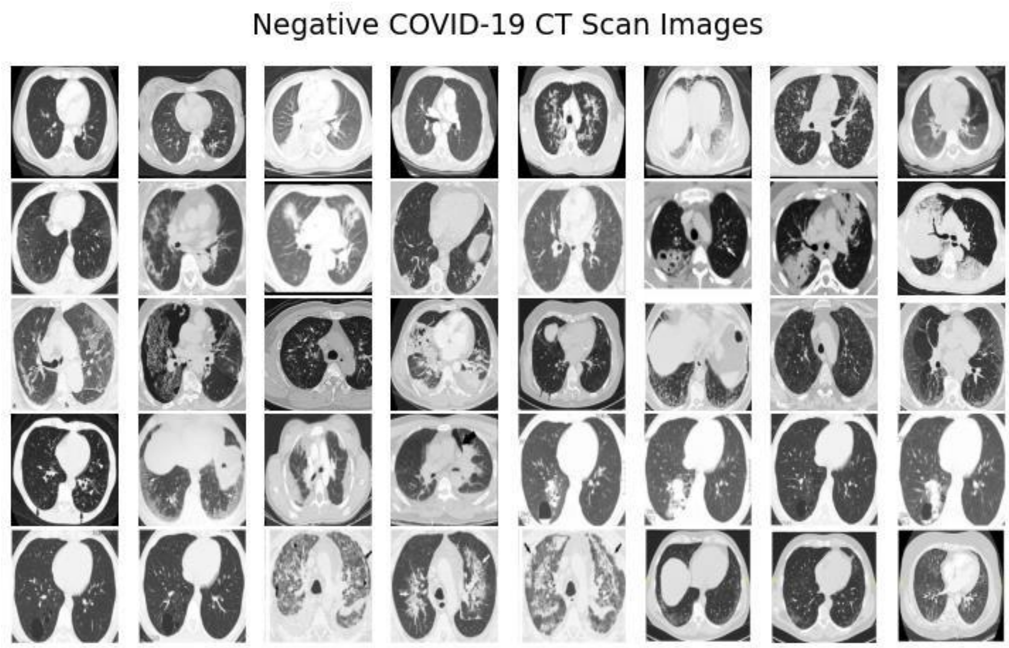

Model:"vgg16"

Layer(type)	OutputShape	Param#
input 1(InputLayer)	[(None,224,224,3)]	0
block1_conv1(Conv2D)	(None,224,224,64)	1792
block1_conv2(Conv2D)	(None,224,224,64)	36928
block1_pool(MaxPooling2D)	(None,112,112,64)	0
block2_conv1(Conv2D)	(None,112,112,128)	73856
block2_conv2(Conv2D)	(None,112, 112,128)	147584
block2_pool(MaxPooling2D)	(None,56,56,128)	0
block3_conv1(Conv2D)	(None,56,56,256)	295168
block3_conv2(Conv2D)	(None,56,56,256)	590080
block3_conv3(Conv2D)	(None,56,56,256)	590080
block3_pool(MaxPooling2D)	(None,28,28,256)	0
block4_conv1(Conv2D)	(None,28,28,512)	1180160
block4_conv2(Conv2D)	(None,28,28,512)	2359808
block4_conv3(Conv2D)	(None,28,28,512)	2359808
block4_pool(MaxPooling2D)	(None,14,14,512)	0

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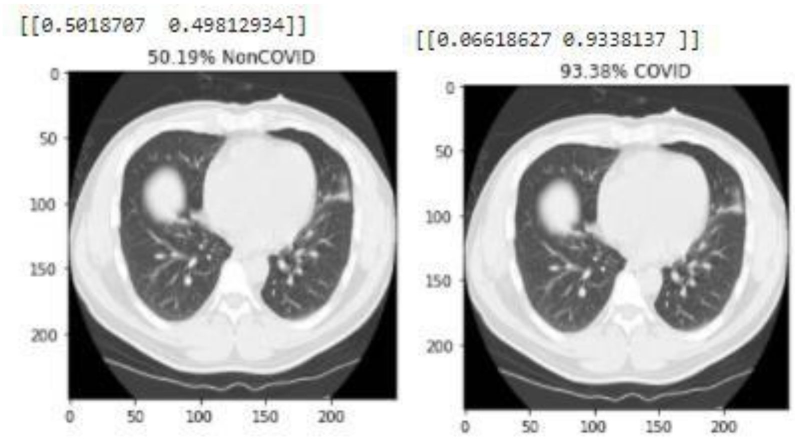
Totalparams:138,357,544
Trainableparams:138,357,544
Non-trainableparams:0



9. CONCLUSION

The version of this diagrams is V2. Most of the formatting guidance in this document have been compiled by Causal management from the IEEE Latex style files. Causal Productions offers both A4 and US Letter diagrams for Latex and Microsoft Word. The Latex diagrams depend on the official IEEEtran.cls and IEEEtran.bst files, whereas the Microsoft Word diagrams are self-contained. contortion neural network (CNN) is quite an adapted deep learning algorithm in the medical field since we get an output just by processing the CT scan images to the various model. The VGG-19model the time taken is 13.69 ms .The method used by us is well-organized one that can be used by the doctors for the mass screening of the patients. It will yield better efficiency and at a fast accurate as compared to the current RT-PCR method. With the above method for the classification of the CT scan images of the COVID-19patients, data can be clipping .which would help the doctors to get the information achievable and quickly

Furthermore, although the planned approach shows great assurance, there is still quite a bit of room for potentially improving the divining performance of the access Recently, ideas like Transfer Learning, Image Augmentation, and Feature Level Fusion have been shown to boost the performance of DL based models excessively.. These ideas are to be explored as part of the future work.

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