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Classification of COVID-19 using convolutional neural network - Resnet-50

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Abstract--The main significance of employing chest X-ray images is to recognize and determine if it is covid or pneumonia. By using these images, it plays a vital role for doctors to save the lives of patients. This is even more important in nations where laboratory kits for testing are not readily available. Deep learning based recognition of COVID-19 using images obtained from chest X-ray is been proposed. For training and testing purposes the ResNet 50 and Xception network is used as convolutional neural network. ResNet 50 contains 48 layers that includes a Max and Average pool. Xception network has 71 layers. Softmax is used as the activation function here to predict multinomial probability distribution. Stochastic Gradient Descent (SGD) is employed for maximising accuracy / SGD is used to enhance accuracy.

Keywords--Convolutional neural network (CNN), ResNet-50, Xception Network, Stochastic Gradient Descent (SGD).

Introduction

During the end of 2019, there arose a sudden unprecedented outbreak affecting humanity by a respiratory syndrome named corona virus disease. By the time when the outbreak of Covid 19 started in Wuhan at China, there was a world wide spread of the epidemic. This illness is still affecting 73,946,295 persons as of February 2022. Numerous fields such as artificial intelligence , machine learning, deep learning, research and development helps the medical team to treat patients and combating ailments by taking into account of time needed for diagnosis and the cost of equipments .One of the primary suggestions in a resource-constrained context, according to the Fleischer Society's recently issued worldwide consensus statement that when there is a limit in availability of computed tomography, the images obtained from chest radiography of covid patients can be employed.

Despite the fact that RT-PCR COVID-19 tests will eventually be employed in clinical settings, The covid 19 will lie between 3 to 48 hours.results acquired from test kits that provide speedy findings. DEEP LEARNING has carved out a niche for itself in the realm of artificial intelligence. The phases which are available in CNN are feature extraction and classification.

The three layers of a typical CNN are convolution, pooling, and fully connected. Medical practitioners are advised by the Fleisher Society to make use of chest x ray and CT in the diagnosis of covid 19, according to the previously mentioned statement. At the final step, imaging modality selection is led to discretion of various medical teams. In the point of service, this study accounts the differences between chest radiography and CT, as well as local resources and competence. This paper proposes that chest x ray pictures be used instead of CT scans of the thorax, due to the latter's longer diagnostic time and expense A ct scan acquired from thorax takes longer duration than chest x ray scan thereby resulting in increased time spent in contact with predicted or diagnosed COVID-19 patients.

Existing system

T.Ozturk et al.[1] employed a deep neural network to automate COVID-19 identification. As a classifier, the Dark Net model is employed. This technology can be used to help radiologists validate the initial screening as well as to screen patients directly through cloud. For binary classes, the accuracy is 98.08 percent, while for multi-class cases, it is 87.02 percent. The authors, G.Litjens and T.Kooi, employed deep learning to analyse medical images and categorise diseases. [2] Data on pulmonary nodules, interstitial lung disease, pneumonia, and tuberculosis was examined by the researchers. COVID-19 and Pneumonia disease were diagnosed using poster anterior chest X-rays by a researcher named P. G. B. Moutounet-Cartan [3]. The model optimizer Adam was employed, which has a 1e-4 learning rate and categorical cross-entropy loss.The results of RT-PCR testing are also examined in this study.

M. M. Rahaman and colleagues [4] developed an automated CAD approach for identifying COVID-19 samples from healthy and pneumonia patients using CXR pictures. With pre-trained CNN models, deep transfer learning techniques are applied. The effectiveness of deep transfer learning algorithms for identifying

COVID-19 situations using CXR is demonstrated in this study. K. He et al. focused on deep residual learning for image identification in [5] in order to make training networks that were far deeper than those previously utilised easier. With reference to input layers, the layers are reformulated as learning residual functions. Sharma and colleagues[6] looked into how to spot pneumonia clouds on chest X-rays. Cropping and extracting images from the lung region were generated using algorithms. The goal of Otsu thresholding is to distinguish between healthy and diseased parts of the lungs. In the framework of Medical Imaging Deep Learning advancements, the authors[7] looked at Computer Vision/Machine Learning. This allows us to use the 'lack of fittingly clarified wide scope datasets' as the key test in this inquiry (among other things).

R. Yamashita, et al paper[8] gives an overview of CNN's underlying theories and applications to numerous radiological tasks, as well as its problems and future implications in the area of radiology. J. Paul Cohen et al [9] described the first public COVID-19 picture data collection as well as a preliminary evaluation of various use cases for the data.

X-Ray pictures are used to diagnose COVID-19, according to L. O. Hall et al [10]. COVID-19 had an overall accuracy of 91.24 percent, with a true positive rate of 0.7879 and 6.88 percent false positives, resulting in a true negative rate of 0.9312 and an AUC of 0.94. Researchers[11] developed a formula that may distinguish pneumonia from chest X-rays. CheXNet is a 121-layer convolutional neural network built on ChestX-ray14, the world's biggest publicly accessible chest X-beam dataset, which contains over 100,000 front facing view X-beam images linked to 14 diseases. Kermany et al. [12] proposed a structure that uses move realisation to prepare a neural organisation with only a minimal amount of data from traditional methods. When this strategy was employed to examine a situation,

The writers evaluated the Dataset of approved OCT and Chest X-Ray images that were presented and examined in "Profound learning-based order and reference of treatable human disorders," according to the authors. The OCT pictures are split into two groups: a preparation group and a self-contained patient testing group. (Disease)-(random patient ID)- (picture number by this patient) CNV, DME, DRUSEN, and NORMAL are the four indexes used to categorise OCT scans. Suganthy, M, and Manjula, S [14] used LabVIEW to develop a non-invasive technique for extracting foetal electrocardiogram (FECG). This allows for FECG monitoring without requiring the acquisition of the mother's cardiac signal. Precision of 96.67 percent has been achieved. [15] discusses Suganthy, M., and Manjula, S.'s work on the performance study of an iris biometric system. Gaussian kernel PCA (GKPCA) and support vector machine are used to extract features for iris recognition (SVM). The accuracy rate is 96.67 percent.

COVID-19 is now diagnosed using a reverse transcription-polymerase chain reaction nucleic acid kit to detect viral nucleic acid (RT-PCR). RT-PCR is the gold standard for COVID-19 analysis, yet there are certain influencing factors, such as pattern series standardisation and pattern series time. In general, scientific imaging techniques are a powerful and efficient way to diagnose COVID-19. Traditional imaging analysis is based on the experience of medical practitioners.

COVID-19 is a novel form of viral disease with unique imaging properties, according to a recent study. Typically, a CT/chest exam will have many slices. An examination by a medical doctor takes 5–15 minutes. One test takes 5–15 minutes for medical specialists to examine. The doctor's intellectual tiredness will be caused by repetitive work. Detection and screening on a large scale are not possible. Doctors can investigate the improvement of a patient's condition using subjective judgements, which are neither obvious or quantifiable.

Proposed system

COVID-19 and pneumonia are recognised in this suggested method employing convolutional neural networks (ResNet50). The convolutional neural network is capable of identifying COVID-19 with little pre-processing and layers.

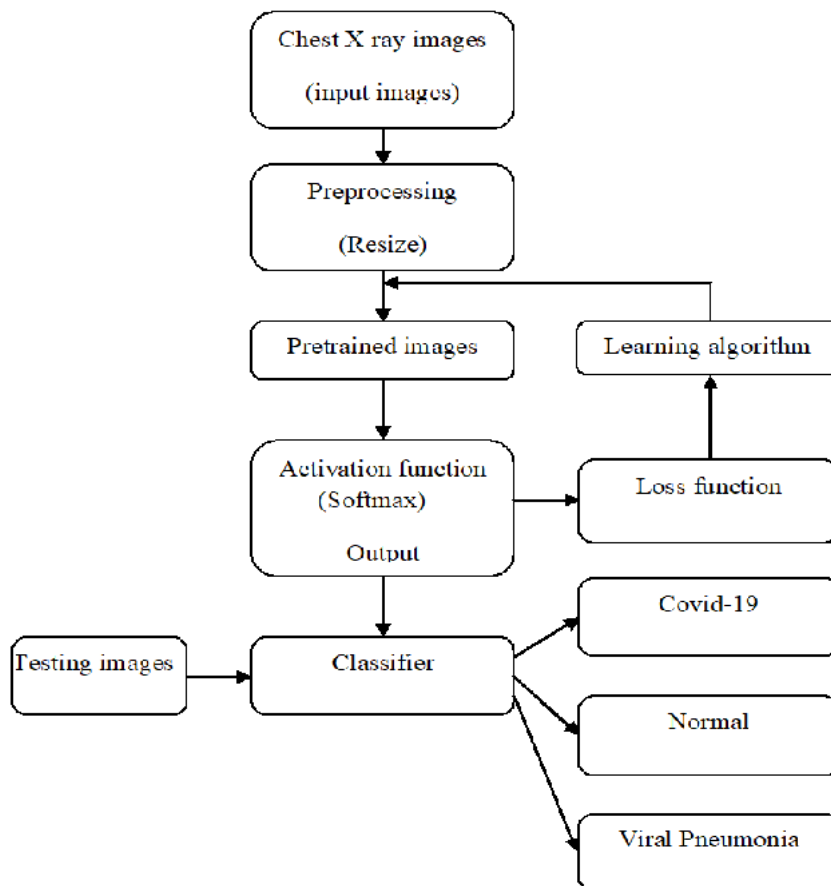


Fig 1. Process Of Detection Of COVID-19, Normal And Viral Pneumonia Using X-Ray Images From Dataset

A) Input images

Based on the images of chest X-ray, the set of data can be broadly classified as COVID-19, normal and viral pneumonia. The set of data has totally 111,70,70 images in it. This dataset can be found at <https://www.kaggle.com/pranavraikokte/covid19-image-dataset?select=Covid19-dataset> on Kaggle.

B) Preprocessing

The images obtained from kaggle source have distinct variety of sizes. Images are been preprocessed with the help of the Xception network and Resnet50, as well as Maxpool and average pool images. The greatest or maximum value of the area is returned by max pooling. The average of the relative average of the area's values is returned via average pooling. As a result, the photos are converted to 254x254 pixels and then shrunk to 128x128 pixels in the preprocessing approach. The implementation is done in Python 3.8.

C) Pretrained images

Images are loaded into the pre-training process in order to construct a model and categorise it into three types. The learning rate, commonly known as the epochs function, is directly proportional to accuracy. Accuracy improves and losses decrease as the learning rate increases.

D) Activation Function

Softmax is a normalisation and prediction function for multinomial probability distributions. The optimizer function SGD (Stochastic gradient descent) is used to help reduce overall loss and enhance accuracy.

E) Classifier

Images of COVID-19, normal, and viral pneumonia of count 26,20,20 are considered in the testing phase with the use of pre-trained images. The classifier will determine whether the output is COVID-19, normal, or viral pneumonia, which will be presented on the screen.

Result and Discussion

Figures 2, 3, and 4 show a database of normal, viral pneumonia, and COVID-19. The readings for Accuracy vs. Loss are provided in table I. As there is a rise in epochs which results in a gradual improvement in accuracy. The curve of epochs and accuracy is presented from fig.5. In fig6, fig7, fig8, the expected result is displayed on the screen by displaying colours red, green, and orange for COVID-19, Normal, and Viral Pneumonia, respectively. Finally, this work has a 95 percent accuracy rate.

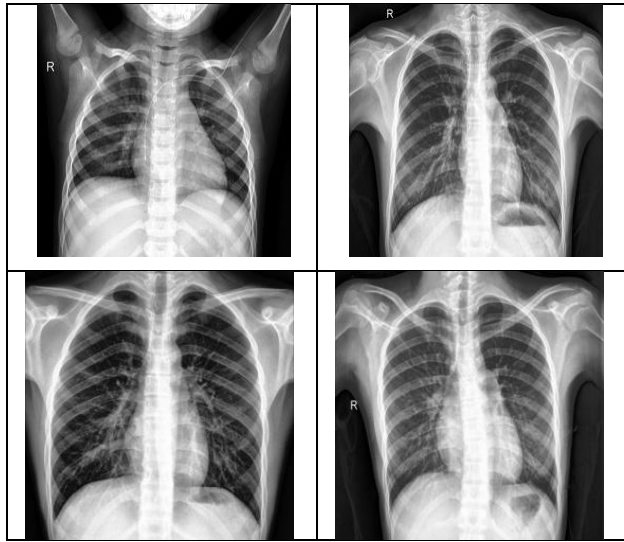


Fig 2.Normal X-Ray

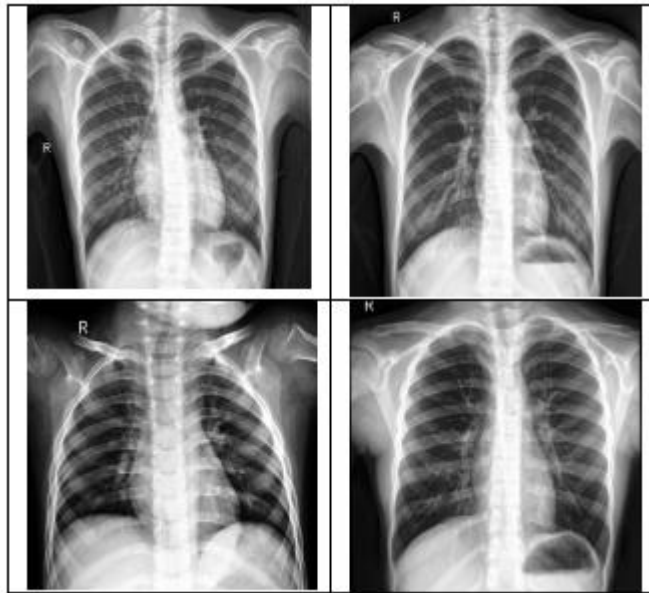


Fig 3.Pneumonia affected

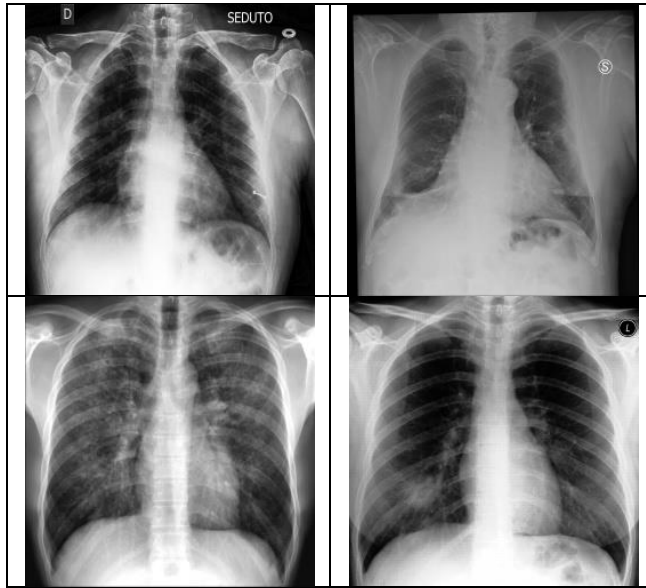
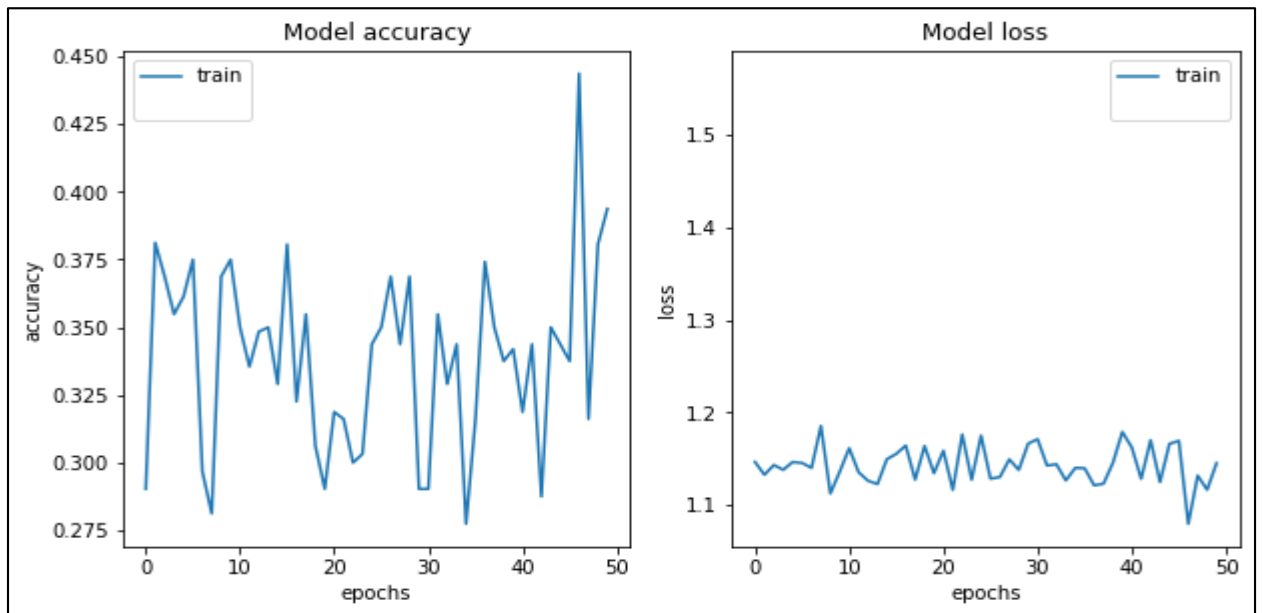
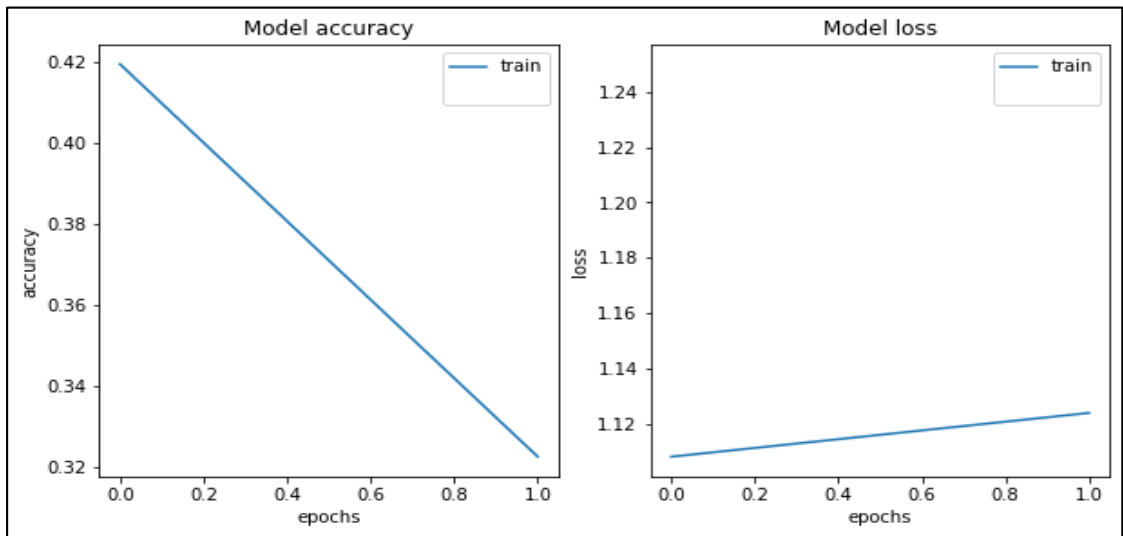
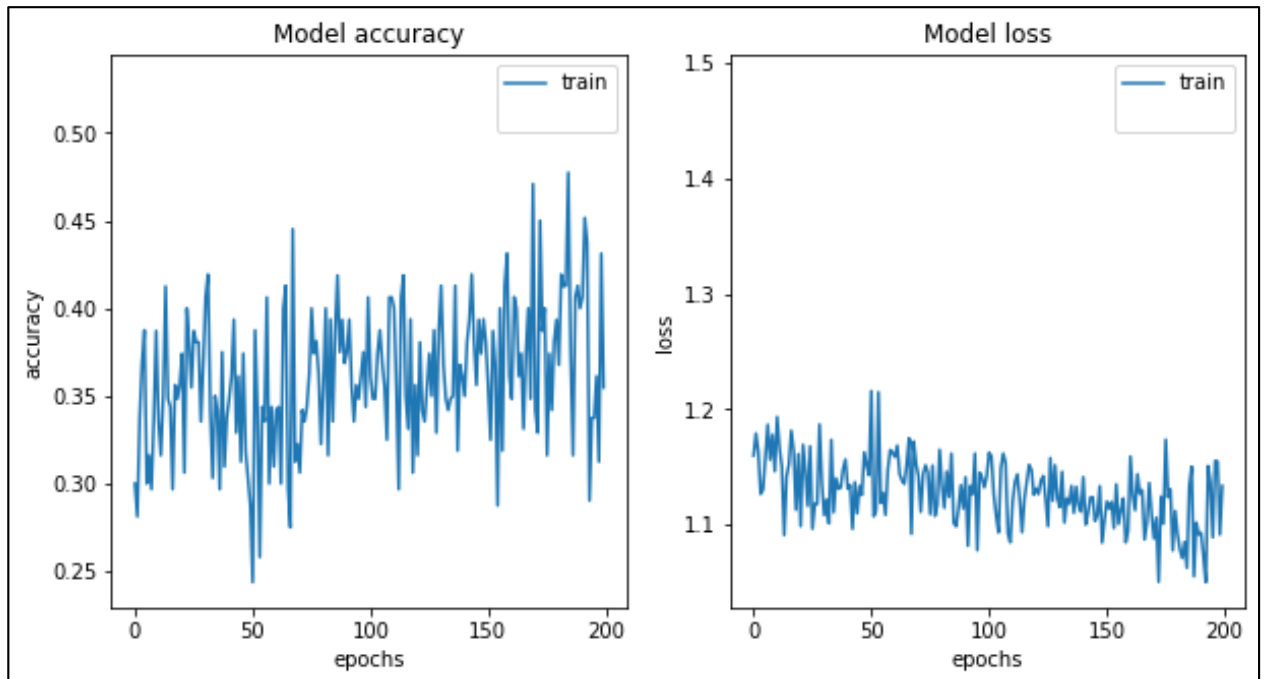
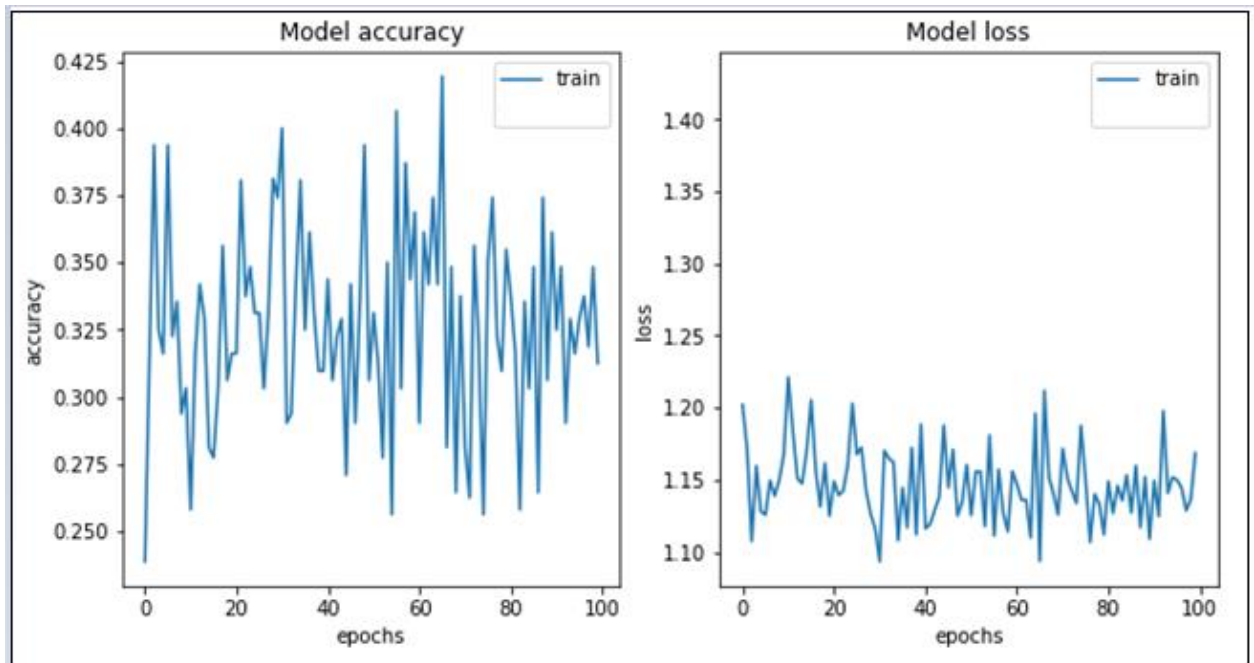


Fig 4. COVID-19 affected

Table 1
Accuracy and Loss for epoch

S.No	Epoch	Accuracy	Loss
1	10	0.37	1.25
2	50	0.54	0.96
3	100	0.59	0.86
4	150	0.63	0.73
5	200	0.69	0.64
6	250	0.78	0.57
7	500	0.87	0.36
8	600	0.91	0.30
9	700	0.97	0.17
10	750	0.92	0.28
11	850	0.96	0.20
12	1000	0.971	0.17





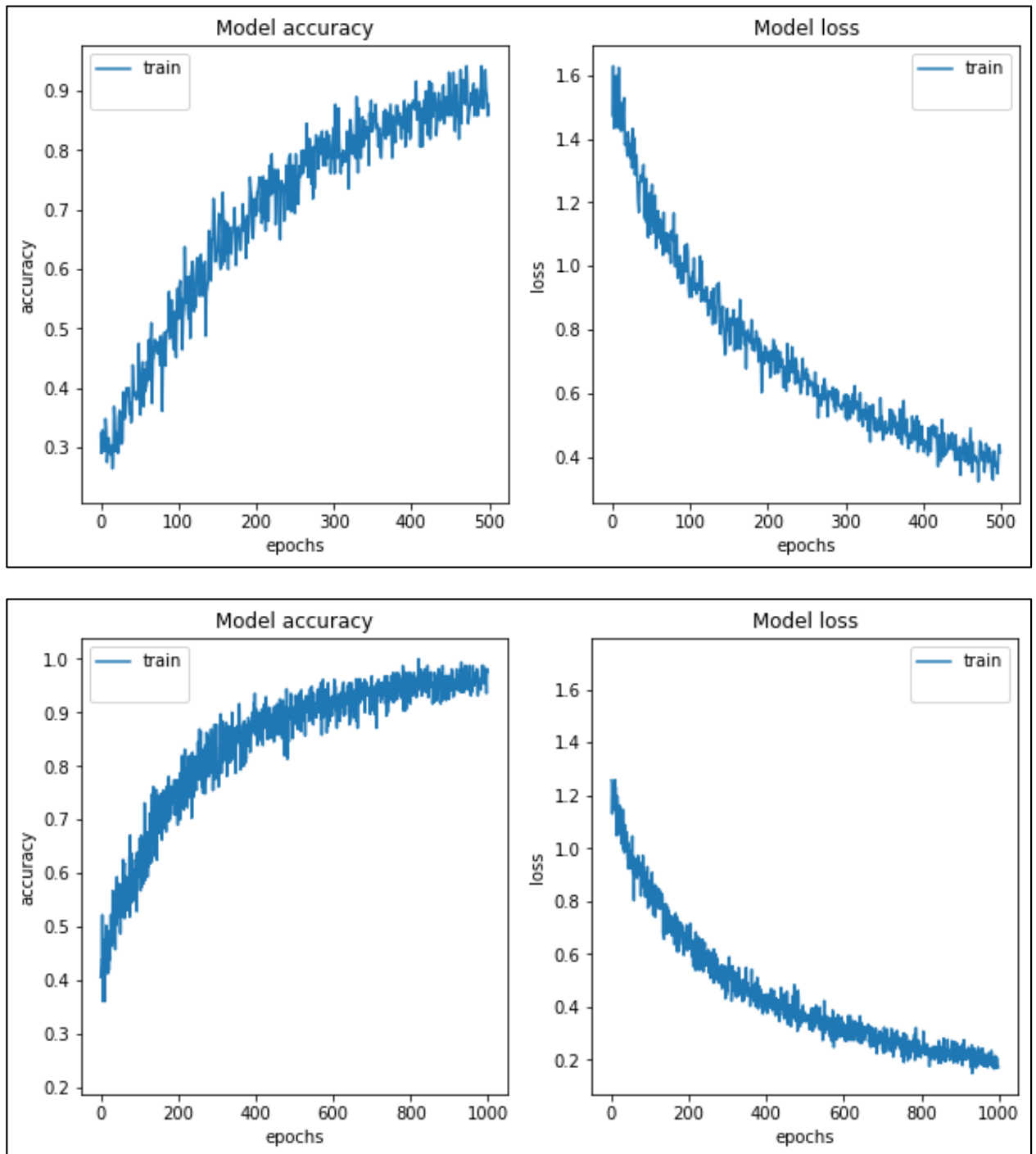
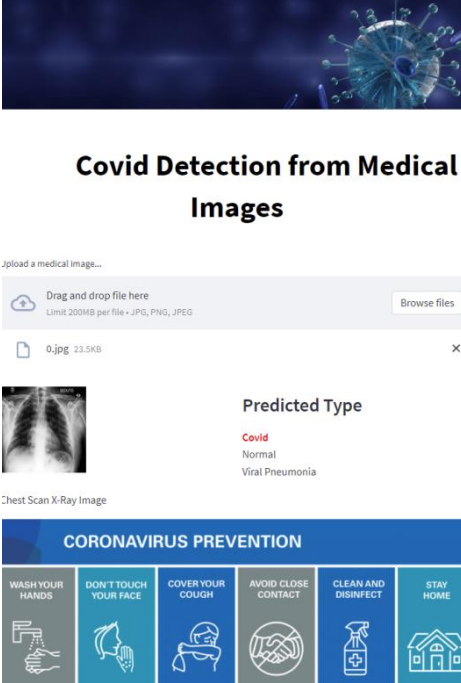


Fig 5. Plot for accuracy and losses




Covid Detection from Medical Images

Upload a medical image...

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Browse files

0.jpg 23.5KB



Chest Scan X-Ray Image

Predicted Type

- Covid**
- Normal
- Viral Pneumonia

CORONAVIRUS PREVENTION




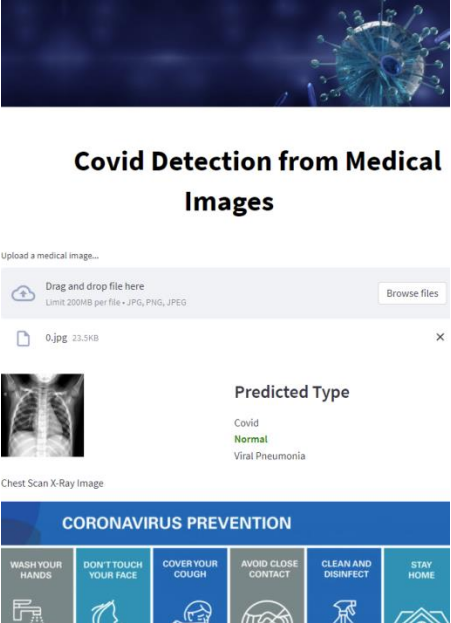
WASH YOUR HANDS	DON'T TOUCH YOUR FACE	COVER YOUR COUGH	AVOID CLOSE CONTACT	CLEAN AND DISINFECT	STAY HOME
					

Fig 6. Predicted output is COVID



Covid Detection from Medical Images

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Chest Scan X-Ray Image

Predicted Type

- Covid
- Normal**
- Viral Pneumonia

CORONAVIRUS PREVENTION





WASH YOUR HANDS	DON'T TOUCH YOUR FACE	COVER YOUR COUGH	AVOID CLOSE CONTACT	CLEAN AND DISINFECT	STAY HOME
					

Fig 7. Predicted output is NORMAL



Fig 8. Predicted output is VIRAL PNEUMONIA

Conclusion

COVID-19, normal, viral pneumonia images are categorised to enable a significant raise level in efficiency and thereby identifying and determining COVID-19 in images chest X-ray. The COVID-19 epidemic is spreading at an alarming rate. Because of the growing number of instances, bulk testing of cases may be necessary. In this work deep learning, Models of CNN are used in categorising COVID-19-afflicted individuals using chest X-ray scans with 95 percent accuracy in this study. CT and MRI scans can also be processed using this deep learning technology in the future to produce even more accurate and efficient results. Aside from COVID - 19 analysis, this could be improved in the future to provide results for a variety of disorders.

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