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HYBRID ALGORITHM FOR DETECTION OF COVID-19 FROM CT SCANS AND X-RAYS

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Abstract: Detecting COVID-19 is a difficult task for medical professionals these days due to its rapid spread. To overcome this problem, various techniques and detection methods to control the spread of COVID-19 are used. CT (Computed Tomography) Scan and X rays are currently used in the detection of COVID-19. This type of diagnostic method is accurate and fast and can be used along with normal covid-19 testing methods. The normal covid-19 testing methods such as RT-PCR method requires a radiologist to detect the disease. Therefore, it is important to implement a system to detect the corona virus automatically as an alternate quickly. This is intended to help doctors detect computed tomography (CT) images and X-Ray images of patient's lungs infected with COVID-19. In this proposed system a Deep Learning algorithm which uses four Convolutional Neural Network (CNN) models: InceptionV3, ResNet50, Xception and VGG16 are used. These convolutional neural network models are pre-trained and we used the dataset obtained from open source which contains CT scans and X-Rays to retrain the model for the detection of Covid-19. The combined models are used for the prediction of images given by the user in a web-based prediction method. Thus, the suggested hybrid algorithm is effective for predicting images as covid or non-covid.

Keywords: Hybrid Model, CT scans and X-rays, Deep Learning Model, and CNN.

I.INTRODUCTION

The Covid-19 virus has clinical manifestations of respiratory diseases, including cough, fever and lung inflammation. Although COVID-19 has a relatively lower death rate currently, it's spread rate is astonishing, and it can even spread through non-symptomatic virus carrier persons. In terms of susceptible people, especially the aging people with one or more illness, the disease may cause deadly complications potentially. As an integral part of the evaluation of COVID-19, CT scans and x-rays are playing an important role in detection of the covid-19 virus. The problem with the detection of covid-19 virus is that the number of radiologists is very less than the number of patients, which causes early and mild level covid affected patients with no access to effective and timely treatments. Under such circumstances, there is an urgent need to develop a faster and more effective detection algorithm. So, in the proposed study, we suggest a deep learning algorithm for the diagnosis of COVID-19 from CT scans and X-rays. Compared with other existing methods, such algorithms can analyse the results of CT scan and x-ray images in a short time, which can save more time and avoid direct contact with the affected persons.

In the proposed system, the four convolutional neural networks (CNN) are trained using CT scans and X-rays dataset containing Covid and non-Covid images. The Deep learning models that are used are InceptionV3, Xception, VGG16 and ResNet50. The models are pre-trained on ImageNet and for this algorithm we retrain the images using dataset obtained from publicly available sources. The trained models are saved and they are combined together for prediction process. The input image from the user is taken and the combined model which is already trained and tested using the datasets of CT scans and X-Rays are used for predicting whether the patient has covid-19 or non-covid. The web-based interface displays the result to the user. Thus, Radiologists and doctors can predict whether the person has covid-19 using the CT scans and X-Rays. By this way, it promotes an effective method for prediction of covid-19 using CT scans and X-Rays.

II.RELATED WORKS

COVID-19 detection in CT images with deep learning: A voting-based scheme and cross-datasets analysis. In this approach, the images from a given patient are classified as group in a voting system. The approach is tested in the two biggest datasets of COVID-19 CT and X-ray analysis with a patient-based split. A cross dataset study is also presented to assess the robustness of the models in a more realistic scenario in which data comes from different distributions. The cross-dataset analysis has shown that the generalization power of deep learning models is far from acceptable for the task since accuracy drops from 87.68% to 56.16% on the best evaluation scenario. These results highlighted that the methods

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that aim at COVID-19 detection in CT-images have to improve significantly to be considered as a clinical option and larger and more diverse datasets are needed to evaluate the methods in a realistic scenario [1]. Detection of COVID-19 from X-rays using hybrid deep learning models. In this paper, a hybrid deep learning model is proposed for the detection of coronavirus from chest X-ray images. The hybrid deep learning model is a combination of ResNet50 and MobileNet. Both ResNet50 and MobileNet are light deep neural networks (DNNs) and can be used with low hardware resource-based personal digital assistants (PDA) for quick detection of COVID-19 infection. [2]. COVID-19 Diagnosis from Medical Images Using Transfer Learning. In this research, eight convolutional neural network models were trained to automatically detect and diagnose COVID-19 from medical imaging, including X-ray and CT scan images. The main contribution of this study is as follows: several deep learning models, specifically convolutional neural network (CNN), were trained on publicly available datasets. The use of different types of medical images, CT scan and X-ray, to train deep learning models. It provided experimental comparative study to the different deep learning models that were trained and selected the best performing one as the suggested alternative method to diagnose COVID-19 using computational techniques [3]. Diagnosis of COVID-19 using CT scan images and deep learning techniques. The deep learning techniques used in the proposed method is based on a convolutional neural network (CNN). This focuses on differentiating the CT scan images of COVID-19 and non-COVID 19 using different deep learning techniques. A self-developed model named CTnet-10 was designed for the COVID-19 diagnosis, having an accuracy of 82.1%. Also, other models that tested are DenseNet- 169, VGG-16, ResNet-50, InceptionV3, and VGG-19. The VGG-19 proved to be superior with an accuracy of 94.52% as compared to all other deep learning models [4]. Automated Detection of COVID-19 from CT scans using Convolutional Neural Networks. COVID-19 is an infectious disease that causes respiratory problems similar to those caused by SARS-Cov (2003). In this paper, a prospective screening tool was proposed where in it use chest CT scans to diagnose the patients for COVID-19 and pneumonia. A set of open-source images, available as individual CT slices, and full CT scans is used to train the model. The model builds a 2D segmentation model using the U-Net architecture, which gives the output by marking out the region of infection. Our model achieves a sensitivity of 0.96 (95% CI: 0.88-1.00) and a specificity of 0.88 (95% CI: 0.82-0.94). Additionally, it derives a logic for converting our slice-level predictions to scan-level, which helps to reduce the false positive [5]. COVID-19 detection from Xray and CT scans using transfer learning. In this research, deep learning models using Transfer learning to detect COVID-19. Both X-ray and CT scans were considered to evaluate the proposed methods. The proposal makes three pillar-structures. First a data augmentation strategy is employed for the purpose of increasing the size of original dataset. Second, a first pretrained model DenseNet convolution network is applied to the augmented dataset. Third, a second pre-trained model using Inception V3 is employed on the augmented dataset as well. This model outperformed the baseline models, constituted of DenseNet and InceptionV3 models by at least 12 percent using novel deep learning architectures using Transfer learning to detect COVID-19 for both X-ray and CT scans [6].

III. EXISTING SYSTEM

The existing System trained eight convolutional neural network models to detect and diagnose COVID-19 from medical imaging, including X-ray and CT scan images. Those deep learning networks have a predefined structure in which its re-train on medical images to serve the purpose, which is called transfer learning. The Xception network model has achieved an overall performance on CT scan of 84%, 91%, and 77% for accuracy, sensitivity, and specificity, respectively. The overall performance for NASNetMobile model for X-rays is accuracy 75%, sensitivity 78%, and specificity 73% respectively. The existing system used only limited number of medical images used for training and testing the model.

IV.PROPOSED SYSTEM

In the proposed system, a deep learning algorithm which uses convolutional neural network is proposed for detecting covid 19 by use of the computed tomography (CT) Scans and X-Rays of patients. The convolutional neural network (CNN) uses various architecture for image classification. Hence, the proposed work utilizes CNN architectures like Inception V3, Xception, VGG 19 and ResNet50 for classification of CT scan images. Then, the four models are combined together for predicting the covid 19. Finally, the web-based interface for the user, displays the result based on the given CT scan and X-Ray image, such as Covid or Non-covid.

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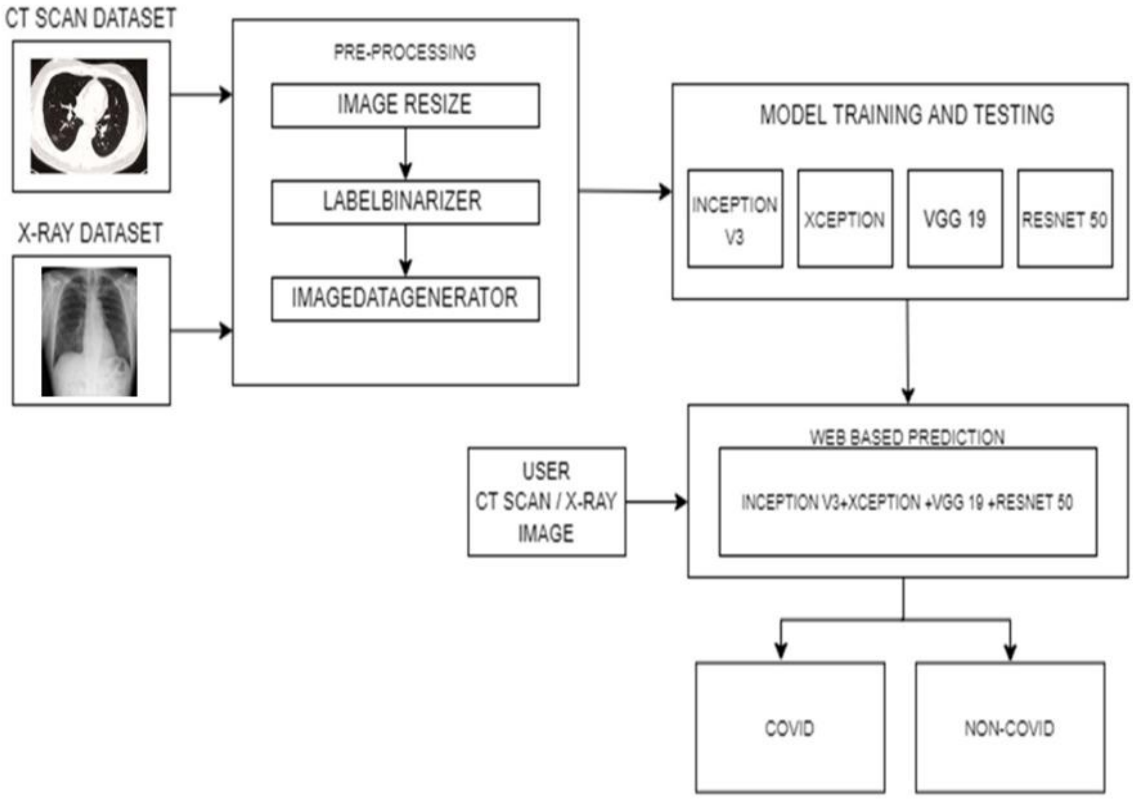

Fig.4.1 Architecture Diagram

V. MODULE DESCRIPTION

The module description describes each of the modules briefly with its workings and the process. Thus, the modules are described below.

A. PRE-PROCESSING

In Pre-processing, the images need to be resized to a fixed size before they can be fed to the deep learning models for training. The images are resized to a size of 224 x 224 pixel which is considered to be the ideal size for training the model. Then BGR image are converted to RGB because several images in the dataset have different pixel orderings. Label Binarizer is an SciKit Learn class that accepts Categorical data as input and returns an NumPy array for the given covid and non-covid images. Thus, it converts labels into categories - either 0 or 1 as covid and non-covid. Image Data Generator is used to train the models at modified versions of the images, such as at different angles, flips, rotations and shifts.

B. MODEL TRAINING

For training the model, the four deep learning CNN models that are used are Xception, Resnet50, Inceptionv3 & Vgg19. These models are pre-trained on ImageNet dataset, so in order to train the model using own dataset, the include top argument can be set to False, and also the trainable layers are set as false, which causes the fully-connected output layers of the model used to make predictions is not loaded, allowing a new output layer to be added and trained. Now the customized layers are added such as flatten layer to flatten the feature of the model, the dropout layer to overcome overfitting and Dense output layer using SoftMax activation function are added. The model is compiled using Adam optimizer and categorical cross entropy loss function. The dataset is split into training and testing for the model.
In the dataset, 80% of the images were used for training the models and the remaining 20% for testing the accuracy of the models. The labels undergo X train and Y Train as well as X Test and Y Test. For the training and Testing, the both covid and non-covid labels are concatenated. The four model are trained for 50 epochs with a batch size of 32 images and tested for remaining 20 % of the data.

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C. WEB-BASED PREDICTION

The Web based prediction of images is done using flask web framework. The trained models are saved along with their weights and accuracy then they are combined together to get predictions. There are mainly two labels for prediction namely covid and non-covid. The image from the user is done pre-processing by normalizing them and converting them into a NumPy array. The predictions from the combined model are taken by using predict class in keras and the array is summed. Then argmax () operation of applied machine learning function is used to get the highest probability value of the class labels in the array for an object. So, the final prediction is done and output obtained is in the form of covid or non-covid for the given CT scan or x-ray image.

VI.RESULT AND DISCUSSION

In this work, a hybrid model for the detection of COVID-19 in CT images and X-rays using deep learning models, namely Inception V3, Xception, VGG19 and ResNet50 are proposed to detect covid-19 with the help of CT scans and X-rays. The proposed model present comparable results to the state-of-the-art methods and high accuracy compared to existing model. This model could enable the use on devices with low computational power, such as smartphones and tablets or even facilitate integration through a web-based interface. The model yield highest accuracy of 92% for Inception v3 model for CT scans and highest accuracy for X-rays is obtained for the models Xception and VGG 19 which is 89%. With this model for the classification of the CT scan images of the COVID-19 patients, users can detect covid-19 using CT scans and x-rays quickly and feasibly on a web-based interface.

Table.6.1. Performance metrics for CT scans

Model		Precision	recall	F1-score	support	Accuracy
InceptionV3	0	0.97	0.85	0.91	87	0.92
	1	0.88	0.98	0.93	101	
VGG-19	0	0.85	0.94	0.89	87	0.89
	1	0.95	0.85	0.90	101	
Xception	0	0.73	0.89	0.80	70	0.79
	1	0.88	0.71	0.79	80	
Resnet-50	0	0.65	0.70	0.68	70	0.69
	1	0.72	0.68	0.70	80	

Table.6.2. Performance metrics for X-Ray

Model		Precision	recall	F1-score	support	Accuracy
InceptionV3	0	0.76	0.98	0.86	83	0.85
	1	0.97	0.75	0.85	101	
VGG-19	0	0.80	0.99	0.89	83	0.89
	1	0.99	0.80	0.89	101	
Xception	0	0.84	0.92	0.88	83	0.89
	1	0.93	0.86	0.89	101	
Resnet-50	0	0.56	0.95	0.71	83	0.65
	1	0.91	0.40	0.55	101	

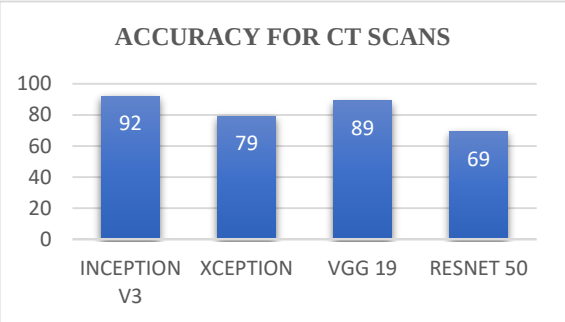

Fig.6.3. Accuracy graph for CT scans

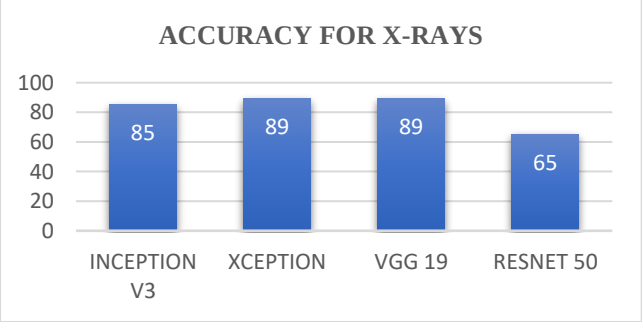

Fig.6.4. Accuracy graph for X-Rays

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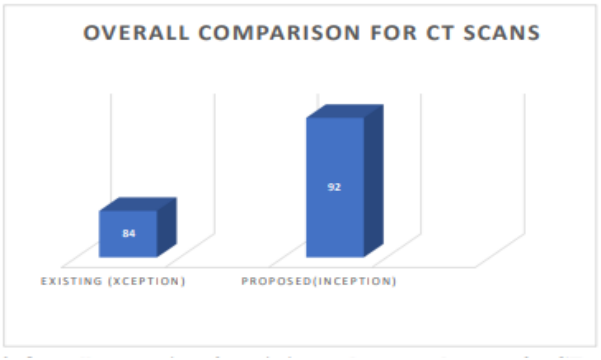

Fig.6.5. Overall comparison for existing and proposed system for CT scans.

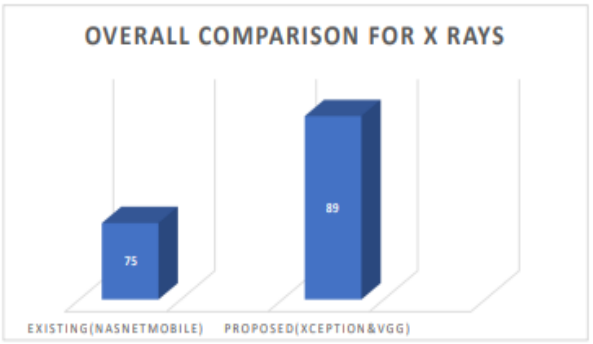

Fig.6.6. Overall comparison for existing and proposed system for X-Rays.

VII.CONCLUSION

The proposed system used Deep learning based Convolutional neural network models which effectively classified the images as Covid or Non-covid. This method is well-organized one that can be used by the doctors for the large number of screenings of the patients. The model outperforms the existing system and increased accuracy is obtained. Additionally, a web-based user interface was developed for detecting the covid-19 in CT scans and X-Rays for the user input image. As for future enhancement more diverse datasets can be used and there will be considerable increase in accurate predictions. The usage of more computational power systems will yield faster detection rates. So, these can be considered for the future enhancement of the model.

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