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Detection of Covid-19 Using X-Ray Images

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ABSTRACT: 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.

A clinical study of COVID-19 infected patients has shown that these type 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.In this study, a deep learning model called Covolutional Neural Network is used for the automatic detection of COVID-19 detection using raw chest X-ray images. The proposed model is developed to provide accurate diagnostics for binary classification (COVID vs. Normal). Our model produced an accuracy of 93.33%.We have also added an interface so that it could be easy to predict whether the patient is diagnosed with covid or not using his/her chest x-ray image. By adding the interface, user interaction with the system will be more.

KEYWORDS: Coronavirus(COVID 19), Deep learning, Convolutional Neural Networks, Chest x-ray images.

I. INTRODUCTION

Covid-19 is a severe disease issue where a large number of people lose their lives every day. This disease affects not only a single country, and even the whole world suffered because of this virus disease. In the past decade, several kinds of viruses (like SARS , MERS, Flu, etc.) came into the picture, but they stand for only a few days or few months. Many scientists are working on these kinds of viruses, and few of them are diagnosed due to the availability of vaccines prepared by Scientists and researchers. In the present time, the whole world is affected by Covid-19 disease , and the most important thing is no single country scientists can prepare a vaccine for the same.

Meanwhile, many more predictions came into a picture such as plasma therapy, X-ray images , and many more, but the exact solution of this deathly disease is not found. Every day, people lose their life due to covid-19, and the diagnostic cost of this disease is very high in the context of a country, state, and patients. In March 2020, X-ray images of healthy people and Covid-19 infected peoples were available online in different repositories such as Github, Kaggle for analysis. Covid-19 is an epidemic disease that threatens humans at a global level and turned into a pandemic. To diagnose covid-19 infected patients with healthy patients is a critical task. The dialysis of Covid-19 infected patients needs more precaution and must be cured under very strict procedures to reduce the risk of patients unaffected with covid-19.

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 (Computerised Tomography) images and chest X-ray images. For contributing to an analysis of Covid-19, we collected uploaded data of X-ray images of healthy and covid-19

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infected patients from different sources. The analysis of this collected data is done with the help of CNN, a machine learning tool. This work mainly focuses on the use of CNN model for classifying chest X-ray images for coronavirus infected patients.

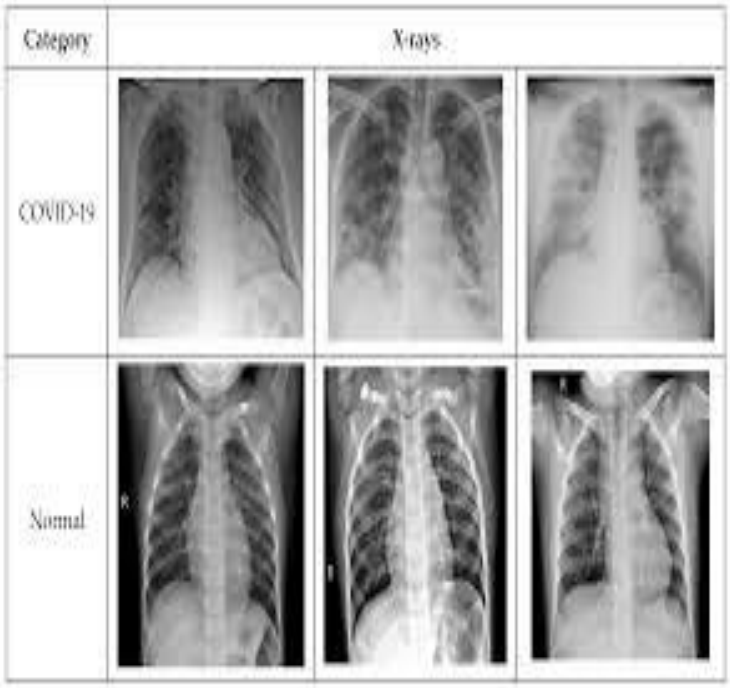

Fig 1: chest x-ray images of covid and normal persons

II RELATED WORK

Studies diagnosed with COVID-19 using chest X-rays have binary or multiple classifications. Some studies use raw data while others have feature extraction process. The number of data used in studies also varies. Among the studies, the most preferred method is convolutional neural network (CNN).

Apostolopoulos and Bessiana used a common pneumonia, COVID-19-induced pneumonia, and an evolutionary neural network for healthy differentiation on automatic detection of COVID-19. In particular, the procedure called transfer learning has been adopted. With transfer learning, the detection of various abnormalities in small medical image datasets is an achievable goal, often with remarkable results. Based on chest X-ray images, Zhang et al. aimed to develop a deep learning-based model that can detect COVID-19 with high sensitivity, providing fast and reliable scanning. Singh et al. classified the chest computed tomography (CT) images from infected people with and without COVID-19 using multi-objective differential evolution (MODE) based CNN. In the study of Chen et al, they proposed Residual Attention U-Net for automated multi class segmentation technique to prepare the ground for the quantitative diagnosis of lung infection on COVID-19 related pneumonia using CT images. Adhikari's study suggested a network called “Auto Diagnostic Medical Analysis” trying to find infectious areas to help the doctor better identify the diseased part, if any. Both X-ray and CT images were used in the study. It has been recommended DenseNet network to remove and mark infected areas of the lung [20]. In the study by Alqudah et al., two different methods were used to diagnose COVID-19 using chest X-ray images. The first one used AOCTNet, MobileNet and ShuffleNet CNNs.
Knowledge extraction from medical data can help in detecting diseases in the early stages. Many researchers worked on medical images using CNN algorithm. Gulshan et al. developed a deep learning algorithm by using large datasets to exceed the performance of medical professionals, in a wide set of medical imaging tasks, with the aim of automatically detecting diabetic retinopathy and diabetis macular edema in retinal fundus images where a definite type of an improved neural network to image classification which is called deep convolutional neural.

In this research, we seek to prove the feasibility of applying a deep learning algorithm in early detection of infection with the Coronavirus and to determine whether using the algorithm could lead to the development of an accurate computer-based method to help doctors to identity COVID-19 patients by using x-ray images.

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III.PROPOSED SYSTEM

Using X-ray images for the automated detection of COVID-19 might be helpful in particular for countries and hospitals that are unable to purchase laboratory kits. A deep learning model called Covolutional Neural Network is used to train the dataset. CNN model is computationally efficient algorithm.The main advantage of CNN compared is that it automatically detects the important features without any human supervision.The proposed model is developed to provide accurate diagnostics for binary classification (COVID vs Normal).

IV.DATASET

In this study, X-ray images obtained from two different sources were used for the diagnosis of COVID-19. The X-ray images with normal symptoms were collected from the kaggle[1]. The COVID-19 X-ray image database which was developed by Cohen JP using images from various open access sources can be accessed from the Github[2]. This database is constantly updated with images shared by researchers from different regions.The collected Chest X-ray images dataset contains X-ray images divided into training (80%) and (20%) for testing.

V.METHODOLOGY

CNN image classifications takes an input image, process it and classify it under certain categories.Technically, deep learning CNN models to train and test, each input image will pass it through a series of convolution layers with filters (Kernals), Pooling, fully connected layers (FC) and apply sigmoid function to classify an object with probabilistic values between 0 and 1.

For this algorithm we have used Keras Library.**Keras** is a powerful and easy-to-use free open source Python library for developing and evaluating deep learning models. We use Sequential model in Keras.It allows you to easily stack sequential layers (and even recurrent layers) of the network in order from input to output.

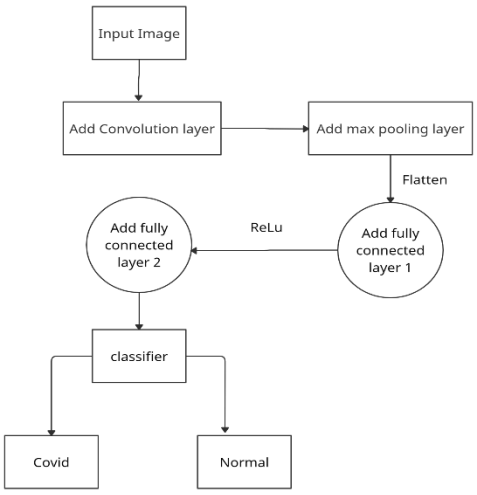

Fig 2: CNN architecture

The approach used for implementing the proposed model is discussed below

Step 1: Data preprocessing
We have utilized Keras data generator for this purpose

Step 2: Build the model

- Add first layer (Convolution 2D): We use 32 output filters in the convolution 3*3 filter matrix that will multiply to input RGB size image 224*224 and use activation=relu.
- Apply (MaxPooling2D), Processing, Hidden Layer 1 (2*2 matrix rotates, tilts) to all the images.First, three layers can be added many times to improve the accuracy and make a better generalized model.
- Adding Flattening: converts the matrix in a single array.

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- Adding full connection (128 final layer of outputs, activation=relu & Dense layer, activation sigmoid).
- Compiling the model with optimizer 'Adam'.

Step 3: Training the model
Our developed system is able to perform binary task with an accuracy of 93.33%.

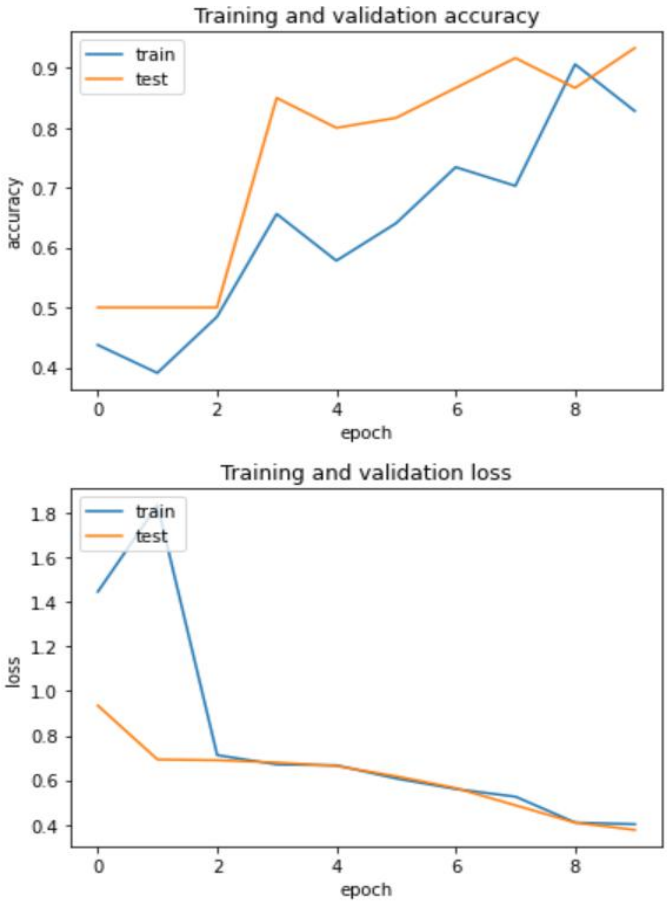

Fig 3: graph depicting loss and accuracy

Step 4: Testing the model

Our model predicts whether the patient has covid or not with his/her x-ray image.

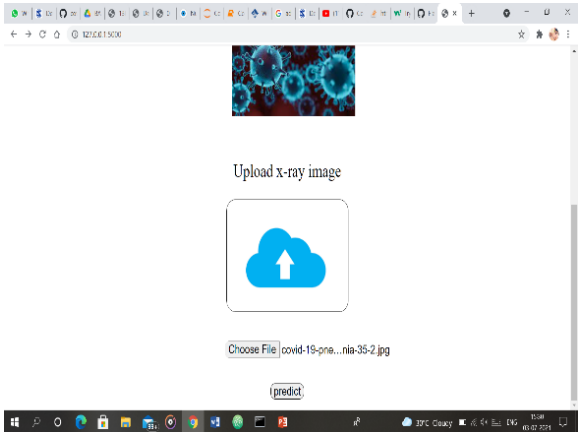

Fig 4: uploading image

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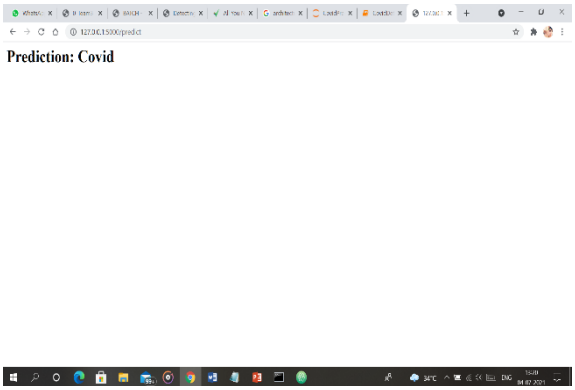

Fig 5: prediction result

VI.FUTURE SCOPE

In the future, the chest X-ray images of new variants in covid like Delta-Variant can be considered to validate our model.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.

VII.CONCLUSION

In this study, we have proposed a deep learning based model to detect and classify COVID-19 cases from X-ray images. Our developed system is able to perform binary task with an accuracy of 93.33%. This system can be used in remote places in countries to overcome the shortage of radiologists. Also, this model can be used to diagnose other chest-related diseases including tuberculosis and pneumonia.

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