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DETECTION COVDI-19 FROM CHEST X-RAY IMAGES

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Abstract : The Corona Virus (Covid-19) is a pandemic disease which is speeded world wide is highly transmittable . Early diagnosis of Covid-19 is isolating the positive cases and preventing the further spread of the disease. A major step to fight against Covid-19 with one of the screening approach is Radiography of chest X-ray images with the characteristics of the patient infected with Covid-19, Pneumonia, Normal were taken. In this we use a CNN (Convolution neural network) deep learning AI algorithm is used which plays a vital role in detection of image, to achieve the better result CNN Algorithm has been used. In this we have taken the dataset of 6,432 images which were collected from the kaggle dataset consist of covid-19, pneumonia, normal.

Index Terms - Covid-19 Detection**,** CNN (Convolution Neural Networks), deep learning , X-ray images(Covid-19 , Pneumonia, Normal)

I. INTRODUCTION

In December 2019, A new Corona virus disease have been identified covid-19 with the aid of potential of the world health organization, It was started in the Wuhan, Hubei, china .Covid-19 belongs to corona virus family which additionally consist of the SARS Virus(Severe Acute Respiratory Syndrome[5]) and MERS(Middle east Respiratory Syndrome[5])virus. The infection begins with the flue like symptoms, they are dizziness, breathlessness, and headache, dry cough(sooner or later result in phlegm) and in few stipulation loss in scent and taste, and in more cases cited diarrhea and fatigue. There is a direct correlation between covid-19 and ARDS, Immoderate instances of covid-19 infection leads to ARDS and Pneumonia.

As this disease spreads from human to human and is highly contagious, people have been advised to wear mask and maintaining the social distancing .Also the infected/suspected individuals are asked to isolate themselves so that they do not act as a carriers for others.

Some of the Medical diagnostic test like RT-PCR[12] , Chest –X -ray were taken around the whole world is facing severe challenges to facilitate testing for more people , so that required Isolation can be done properly .But the supply of RT-PCR[12] is limited the demand is growing. people who have been tested but are positive represent a major hazard to others because the nature of other disease is the only factor driving the disease exponential expansion over time. Many persons who come in contact with one diseased person can become affected as well. At present there are 81 million[11] people worldwide have affected with COVID-19, and the fatality rate has reached 1 million[11]. has been infected with COVID-19, and the global mortality rate has reached 1 million[11] individuals. Men are 2.4million times more likely than women to die in covid-19 patients, but both genders are equally susceptible[6]. Men were also more likely to pass away. These photos reveal the amount of irregular ground-glass opacities that develop quickly after the onset of COVID-19 symptoms. These anomalies peaked between days 6 and 11 of the disease. The second most common pattern of lung opacity[3] abnormalities occurs between days 12 and 17 of the illness [12]. Computer-Aided Diagnosis (CAD) systems that include X-ray and CT image analysis

Severe covid-19 Symptoms

- Difficulty in breathing
- Persistent pain or pressure in the chest
- Inability to wakeup or stay awake
- Bluish lips or face

Mild case of covid-19 usually recover in one to two weeks, For severe cases, recovery can take six weeks or more, and for some, there may be lasting symptoms with or without damage to the heart ,kidney and lungs[10].

Stages of covid-19

stage 1:Flue like symptoms

In this stage is the early viral response. Symptoms range from mild to severe and may include fever, chills, cough, shortness of breath, fatigue, muscle or body aches, headache, loss of taste or smell, sore throat, congestion, runny nose, nausea or vomiting, and diarrhea. "47% percent of people are asymptomatic, which is a major cause for unknowingly spreading the disease, "It can take anywhere from two to 14 days for symptoms to appear, which explains the need for quarantining after exposure[10]."

Stage 2:Pneumonia/respiratory symptoms.

This is the stage where virus spreads to lungs and causes pneumonia, This is the critical stage where you we suffer from breathing, chest pain and confusion. And there may be constant coughing and can't take deep breaths, your oxygen level can decrease at this stage. In addition to pneumonia several respiratory problems may occur.

Stage 3:Organ failure

In this lungs go into the hyper inflammatory response, which can lead to sepsis and organ failure patients with covid-19 develop pneumonia.

II Related work:

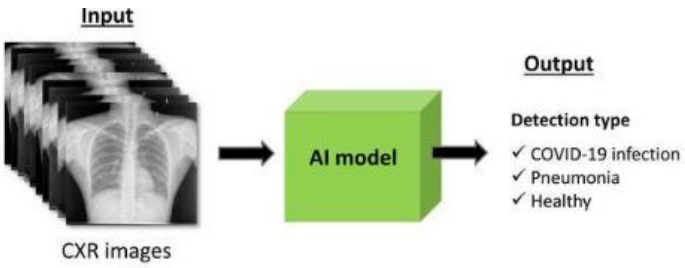

Figure:1 chest X-ray image

In this we consider different chest x-ray images of Covid-19,Pneumonia, normal patient X-ray images have been collected. In this we use CNN , CNN is deep learning algorithm and is used which is the basic layer responsible for extracting the features from the input . Comparing of three different types of chest X-ray and identifying whether the patient having covid-19 . In this we have taken the pneumonia[6] images because there are same symptoms with the patient having the covid-19 and pneumonia. By using python programming language and python packages with the technology of CNN it predict the results.

III METHODOLGY:

DATA SOURCES

The open-source dataset from kaggle[4] .the dataset consist of 6,432 images of three classes covid-19, pneumonia, normal. For Training 5144 images were used, and 1288 images were used for testing.

Figure :2 Comparisons of 3 types of chest X-ray images

Normal Chest X-ray: In a normal chest X-ray fig2:(a) the lungs appear clear and transparent. The lung fields are visible without any abnormal opacities or infiltrates. The heart, ribs, and other structures may also be visible, but there are no signs of infection or inflammation.

Pneumonia Chest X-ray: In fig(2)b pneumonia, the X-ray may show areas of increased density or opacity[3] in the lungs. These areas represent consolidation, which occurs when air spaces in the lungs fill with fluid, pus, or inflammatory cells. The affected areas may appear as patchy or lobe-based opacities. Pneumonia can affect one or both lungs.

COVID-19 Chest X-ray: COVID-19 fig(3) pneumonia can present with similar radiographic features as other types of pneumonia. The X-ray may show areas of patchy opacities or consolidations in the lungs. However, COVID-19 pneumonia can have a more peripheral and bilateral distribution, meaning it may affect the outer edges of the lungs and appear in both lungs. It can also have a ground-glass appearance, which refers to a hazy or fuzzy opacity[3].

DATA PREPROCESS

Data preprocessing is an extremely crucial step for both ML Algorithm. It improves the accuracy of the dataset. The original image size is 2000*2000 we convert all images into 224*224*3. After resizing the image, we got better results when compared with the original pixel values.

ROLE OF CHEST X-RY IN DIAGNOSIS

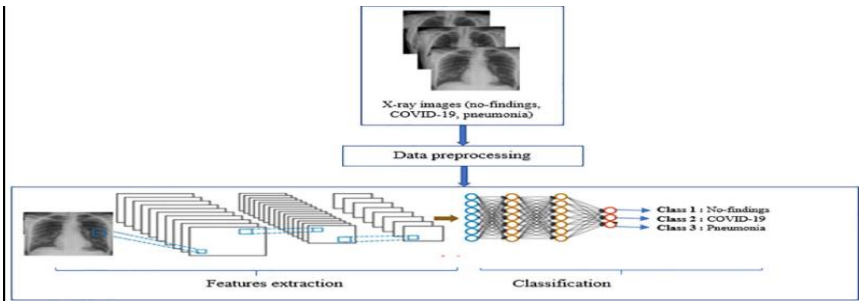

Figure:3.Feature Extraction

As mentioned in the above fig(2) CNN Architecture ,In the process of feature extraction[9] A Convolution tool identifies the characteristics of feature analysis. The feature extraction consist of an input ,convolution layer and pooling layer.CNN becomes more complicated with each layer detecting the large areas of the chest X-ray image.
Chest X-rays have played a significant role in the diagnosis[7] of COVID-19 during the pandemic. Diagnosis of COVID-19 relies on laboratory tests, such as the polymerase chain reaction (PCR) test, chest X-rays can provide valuable information in the evaluation of patients suspected or confirmed to have the disease.

- Detecting lung abnormalities: Chest X-rays can help identify characteristic lung abnormalities associated with COVID-19, such as patchy or bilateral ground-glass opacities, consolidation, or infiltrates. These findings can suggest viral [5]pneumonia, which is commonly seen in COVID-19 patients.
- Early identification of severe cases: Chest X-rays can assist in the early identification of severe cases by detecting the progression of lung involvement. Severe cases of COVID-19 often exhibit worsening lung opacities and consolidations, which can be visualized on chest X-rays.
- Assessing disease progression: Serial chest X-rays can be used to monitor the progression of lung involvement and assess the effectiveness of treatment. Follow-up X-rays can help determine if there is improvement, stability, or worsening of lung abnormalities.
- Evaluating complications: Chest X-rays can help detect and evaluate complications associated with COVID-19, such as secondary bacterial pneumonia, pneumo thorax, or pleural effusions. These complications may require specific management and can be identified through chest X-ray findings.
- Triaging patients: In resource-limited settings or when PCR [1] testing is not readily available, chest X-rays may aid in the triage and initial assessment of patients suspected of having COVID-19. Chest X-ray findings, along with clinical symptoms and history, can help guide the management and isolation of patients.

chest X-rays provide valuable information, they are not specific to COVID-19 and can show similar findings in other respiratory infection[1] or lung diseases.

CONVOLUTION NEURAL NETWORKS

Convolutional neural networks (CNNs)[8] are a type of deep learning algorithm specifically designed for analyzing visual data, such as images or videos. They have revolutionized the field of computer vision and have been widely used for tasks such as image classification, object detection, image segmentation, and more.CNN is to exploit the spatial structure of data by using Convolutional layers, which apply learnable filters (kernels) to small local regions of the input. These filters capture different visual patterns, such as edges, corners, and textures, at various levels of abstraction. Through a process called convolution[8], these filters scan the input, producing feature maps that highlight the presence of certain features or patterns.

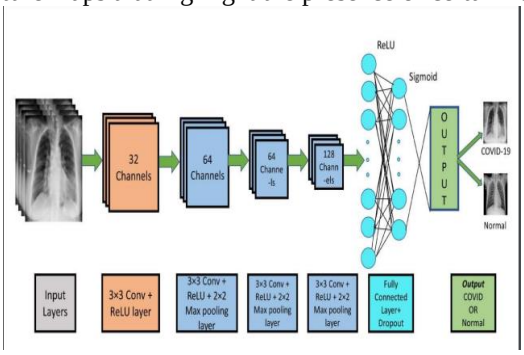

Figure 4:Convolution neural networks

Convolutional neural networks (CNNs) consist of multiple layers that perform different operations on the input data in the above as mentioned in the fig(4). Here are the common layers used in a typical CNN architecture:

Input Layer: The input layer receives the raw input data, such as images or sequences, and passes it to the subsequent layers for processing.

- Convolutional Layer: Convolutional layers perform the main operation of convolution on the input data using learnable filters or kernels. Each filter convolves with the input to produce a feature map, capturing different patterns or features present in the data.
- Activation Layer: An activation layer applies a non-linear activation function element-wise to the output of the previous layer, introducing non-linearity into the network. Common activation functions include RELU (Rectified Linear Unit), sigmoid, and tan.
- Pooling Layer: Pooling layers down sample the feature maps by summarizing and reducing their spatial dimensions. Max pooling and average pooling are widely used techniques, which extract the maximum or average value within a pooling window, respectively.
- Dropout Layer: Dropout layers randomly set a fraction of the output features to zero during training, which helps prevent over fitting by promoting the learning of more robust and generalized features.
- Batch Normalization Layer: Batch normalization layers normalize the activations of the previous layer, making the network more robust to internal covariate shift. It helps stabilize the training process and improves the overall performance of the network.
- Fully Connected Layer: Fully connected layers, also known as dense layers, connect each neuron in the current layer to every neuron in the subsequent layer. These layers capture high-level abstract representations and perform classification or regression based on the learned features.
- Output Layer: The output layer provides the final predictions or outputs of the network. The structure of the output layer depends on the specific task at hand, such as binary classification, multi-class classification, or regression.

IMPEMENTATION

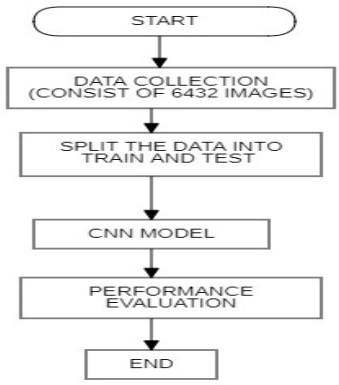

Figure:5 Implementation process

This procedure begins with data collection. As part of this project, we collected data that is already available on the internet. Datasets were collected from Kaggle[4]. The dataset consists of 6432 images. These images are Consist of three types categories: covid-19,pneumonia,normal.

Next, we will split the data. In this step, data is divided into two parts: training data and test data. The split ratio of the data set is (80, 20), i.e. 80% of the data set is used as training data, while the remaining 20% is used as testing data.

After data spitting, the next step is data preprocessing. In the preprocessing step, we convert all the images into 100*100 dimensions. The next step is data labeling. In this step, we represent the data's Covid-19 images as 0,normal as 1,pneumonia as2 images .

After splitting the data into train and test, we chose the CNN Model. The input image size is 224*224*3. we can reduce parameter size by reducing the output of the Convolutional layer[8]. The max-pooling layer consists of a 2*2 pool size with a stride of 2. We get the vectors for the size of 1*1*2048. The size of the output feature vector after flattening is 1*2048. Based on that we get an accurate classification. predicts the whether it the patient has “Covid -19” or not.

IV DISCUSSION

Predicted covid-19 predicted covid-19

Figure:6 Covid-19 Figure:7 pneumonia

The covid-19 has caused by the virus and primarily effects the respiratory system. The infection in lungs can lead to damage of the lungs results in pneumonia. In some cases, the infection progress leading to more severe symtoms and causing pneumonia[6]. In this we consider pneumonia because people who age is more than 65% has the major chances of getting "covid-19 ", here the from the fig(6) pneumonia image has predicted as "Covid -19". A positive result from the "covid-19" test means that there is a high risk that he or she has pneumonia.

V RESULTS AND EVALUATION

To measure prediction performance of the model , we used standard evaluation metrics such as recall, precision, accuracy, and f1-score to assess the prediction performance of the approaches. It provides a summary of the predictions made by the model on a test set, comparing them to the actual labels of the data. False negative (FN) is the number of instances that incorrectly predicted. True negative (TN) is the number of negative instances that predicted correctly, while false positive (FP) is the number of negative instances incorrectly predicted. Given TP, TN, FP and FN, all evaluation metrics were calculated as

	precision	recall	f1-score	support
0	1.00	0.95	0.97	116
1	0.87	0.93	0.90	317
2	0.97	0.95	0.96	855
accuracy			0.95	1288
macro avg	0.95	0.94	0.94	1288
weighted avg	0.95	0.95	0.95	1288

Figure:8 Classification Report

the classification model, such as accuracy, precision, recall, and F1 score. These metrics provide insights into
Recall or sensitivity is the measure of COVID-19 cases that are correctly classified. Recall
is critical, especially in the medical field and is given by:

$$Recall = TP/ (TP + FN).$$

Precision or positive predictive value is defined as the percentage of correctly classified
labels in truly positive patients and is given as:

$$Precision = TP / (TP + FP).$$

Accuracy shows the number of correctly classified cases divided by the total number of test
images, and is defined as:

$$Accuracy = (TP + TN) / (TP + TN + FP + FN).$$

F1-score, also known as F-measure, is defined as the weighted average of precision and
recall that combines both the precision and recall together. F-measure is expressed as:

$$F1 - score = 2 * (precision * recall) / (precision + recall)$$

Epochs	Accuracy	Precision	Recall	F1-Score
10	0.93	0.93	0.89	0.91
30	0.94	0.95	0.91	0.93
50	0.95	0.95	0.94	0.94

Table 1:Results

From the above results of the epochs trails of using the CNN model In which the accuracy has been increased on the each epoch trial.CNN model which shows the equivalent highest score for the accuracy. By using CNN Model . In the context of machine learning, an epoch is a complete pass of the entire training dataset through a neural network. During each epoch, the neural network examines all of the training instances, adjusts its internal parameters (weights and biases), and updates the model to reduce training error**.** The number of epochs is a hyper parameter that controls how many times the training process iterates across the full dataset. It is critical to select the optimum number of epochs to guarantee that the model learns the underlying patterns in the data without Over fitting or Under fitting. We used Keras callbacks to fine-tune our CNN model. We used Model Checkpoint to save the best weights of our CNN in order to plot the properly and erroneously predicted images that will be shown later in this Notebook, and to avoid having to train the model again. This will save us time .

VI CONCLUSION

Chest CT has a high sensitivity for diagnosis of Corona virus disease 2019 (COVID-19). Chest CT may be considered as a primary tool for the current COVID-19 .In this we used CNN A deep learning algorithm on covid-19. Chest X-ray images[10] to estimate the model accuracy prediction. The CNN model performed well at identifying characteristics in an x-ray image and predicting the presence or absence of COVID-19, bacterial, and viral pneumonia[5]. With the advancement of computer-related medical applications, pneumonia and COVID-19 can be effectively identified using chest radiographs with the aid of CNN and deep learning technologies. The estimated uncertainty in deep learning yields more reliable prediction, which can alert radiologists on false predictions, which will increase the acceptance of deep learning into clinical practice in disease detection. By using CNN in prediction helps in early detection of the disease mainly the patients who have been suffering from pneumonia.

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