Identification and Analysis of Corona Virus (COVID-19) Infectious Diseases from Chest X-rays or Radiology Images Using Machine Learning

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Abstract: *The COVID-19 pandemic has modelled significant global health challenges, requiring rapid, accurate, and scalable diagnostic tools. This paper presents a novel machine learning based technique for the identification and analysis of COVID-19 infections using chest x-rays and radiological images. We implemented a classification method of early detection COVID-19 virus is crucial in reducing mortality. (MRI) may be a viable imaging technique for Detecting COVID-19 detection have been studied for computed tomography (CT) images. In this paper COVID-19 virus detection method based on deep learning is proposed for chest X-rays as well as thoracic MR images. With parameter optimizing, spatial input construction, and deep learning, a faster R-convolution neural network (CNN) is designed to locate the Detecting COVID-19 region also we proposed a hybrid deep learning model integrating Convolutional Neural Networks (CNNs) with attention mechanisms Discrete Wavelet Transform (DWT) to enhance feature extraction and localization of infection regions. Our system demonstrates high accuracy, sensitivity, and specificity across diverse datasets, outperforming traditional methods.*

Keywords*: Covid-19, CT (Computed Tomography), CNN (convolution neural network, ML (Machine Learning), DWT (Discrete Wavelet Transform), MRI (Magnetic resonance imaging)*

1. INTRODUCTION

Covid-19 is communicable virus of the inferior respirational territory in families with high mortality worldwide, affecting more than 150 million people as well as the cause of roughly 3.2 million expiries of elders above 65 years [1]. It is often accompanied by cough, fever, pleuritic chest pain, and shortness of breath. Covid-19 can develop to respiratory failure, cardiac arrhythmias, and kidney failure. Covid-19 is a respiratory disease that causes inflammation in one or both lungs, resulting in symptoms such as cough, fever, and difficulty breathing. Early detection of Covid-19 is essential for effective treatment and improved patient outcomes. With current technology, it is impossible to distinguish Covid-19, pneumonia from other lung diseases with certainty [2]. The WHO (World Health Organization) officially declared that people at risk for Covid-19 also include adults over the age of 65 and people with preexisting health problems.

As per the health Severe Acute Respiratory Syndrome Corona Virus - 2 (SARSCOV-2) has directed to probably the worst pandemic of this era in the form of Coronavirus disease 2019. Covid-19 is an enormously transferrable disease, which is originated by the SARS-CoV-2 virus. In February 2020 and afterward scattering more than 105 nations in addition leading to several millions of cases, the WHO (World Health Organization) officially declared the outburst of the new coronavirus as a pandemic Figure 1 shows map for coronavirus related deaths across the globe reported to WHO.

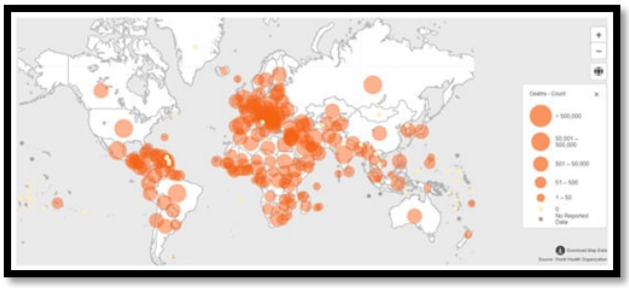


Fig 1. Map for coronavirus-related deaths across the globe reported to WHO on 7 January 2021 (source: World Health Organization, WHO).

The analysis of these viruses achieved by the Reverse-Transcription Polymerase Chain Reaction (RT-PCR) or any other domestic test which later gathering of suitable respirational tract specimen, which is a laboratory-based test for recognition and quantification of a targeted sample. The RT-PCR test can be completed only in laboratories that are fortified with the desirable substructure. Furthermore, in some cases the covid-19 virus test may need be repeated after one or two days while the price of the apparatus and the mandatory PCR chemicals is very high., thus to carried out this diagnostic test is expensive in addition with time consuming, without including the necessity for dedicated microbiologists to prepare the tests examines and the appropriate safety measures (personal protective equipment) that are required to possess laboratory staff safe. Due to these problems and limitations various nations are limiting the achieved diagnostic tests for these viruses to only suspicious cases and/or susceptible groups of people as it is not possible to do gigantic testing of the general population. At the same time governments present isolation measures, which are causing social economic problems, such as increase of the number of domestic abuse cases, reduction of the economic growth [9] and the global trade [8]. Based on the above-mentioned facts, the development of alternative, complementary and low-cost tools for detection of covid virus for positive cases and for decision making support is essential.

The recent development of technology in MATLAB software using DWT feature extraction method along with Deep Learning and medical image processing in combination with big data repositories for viruses could offer support in the global effort against the new coronavirus. Several studies have investigated the potential of using X-ray and/or CT images identify virus classification. An automatic X-ray of virus chest, lung image classification system was presented in, which first increases the contrast of the image by applying a filter on it and using the segmentation classifies infected from non-infected images.

2. LITERATURE SURVEY

In recent months, researcher like Rehman et al. [1] A, Hassali MA, Abbas S, have investigated and analyzed limitation of domestic technologies to detect virus and upgrade with new technology using x-ray.

In recent months, researchers have investigated and analyzed chest X-ray images Chowdhury et al. [3] worked with chest X-ray images to develop a novel framework named PDCOVIDNet based on parallel-dilated CNN. In the proposed method, the authors used a dilated convolution in the parallel stack that could capture and stretch necessary features for obtaining a detection accuracy.

Abbas et al. [4] proposed and validated a deep convolutional neural network called decompose, transfer, and compose (DeTraC) to detect COVID-19 patients from their chest X-ray images. They proposed a decomposition mechanism to check irregularities from the dataset by investigating class boundaries for obtaining a high accuracy.

Azemin et al. [5] used a deep learning method based on the ResNet-101 CNN model. In their proposed method, thousands of images were used in the pre-trained phase to recognize meaningful objects and retrained to detect abnormality in the chest X-ray images. The accuracy of this method was only 71.9%.

El-Rashidy et al. [6] introduced a framework consisted of three layers: patient layer, cloud layer and hospital layer. A set of data was collected from the patient layer using some wearable
sensors and a mobile app. A neural network-based deep learning model was used to detect COVID-19 using the patient X-ray images.

Khan et al. [7] developed a new architecture for the diagnosis of X-ray images as the COVID-19 or normal using pre-trained deep learning models like ResNet50, VGG16, VGG19 and DensNet121, where VGG16 and VGG19 showed the best accuracies. The proposed model consisted of two phases like pre-processing and data augmentation, and transfer learning.

In the proposed model by Loey et al. [8], three deep transfer models like AlexNet, GoogleNet and ResNet18 were employed on a dataset of 307 images with four different types of classes: COVID-19, normal, pneumonia bacterial and pneumonia virus. The research work was distributed into three scenarios to reduce memory consumption and execution time.

Minaee et al. [9] reported a deep learning-based framework to detect COVID-19 from chest X-ray images using four tuning models like ResNet18, ResNet50, SqueezeNet and DensNet-121. The proposed method took advantage of data augmentation to create a transformed version of the COVID-19 images.

Sekeroglu et al. [10] developed a model using deep learning and machine learning classifiers where a total of 38 experiments was conducted by CNN for the detection of the COVID-19 using the chest X-ray images with high accuracy. Among them, 10 experiments were performed using 5 different machine-learning algorithms, and 14 experiments were carried out by the state-of-the-art pre-trained network for transfer learning. They concluded that the system developed by CNN was capable of achieving COVID-19 detection from a limited number of images without any pre-processing and with minimized layers.

3. IMPLEMENTED ALGORITHM

The implemented algorithm is developed to detect and analyze virus like covid-19 and other lung diseases from patient immediate by using images by CNN process. For this purpose, CNN with DWT method can be used in MATLAB software. This study well helps medical staffs, doctors, government officers those are in direct dealing such pandemics more safely. Since, medical treatments have a certain limit, it should utilize other measures as well which is somewhat non-medical.

Radiographs can easily be done at various hospitals and medical centers. Processing the radiographs using the model have defined in this study, can significantly improve the speed of detection of viruses using our proposed methods.

The algorithm of identification and analysis of covid 19 virus using DWT and CNN method using X-rays as well as MRI images. It includes following stages

Input Images: - The input image process was done by this project because there are no publicly available datasets about chest dataset. However, dataset images accurately represent the state of the affected and normal. This is unlikely in less-affected regions and is also treated because images are clear and with blurring which will plan on making a public dataset in the future. The dataset contains images of development stages of Covid-19 x-rays datasets across two classes with about Negative and Positive.

Preprocessing: - Image pre-processing is the term for operations on images like changing the RGB image to a gray one by adjusting the resolution of the image as needed. These operations do not increase image information content however they decrease it if entropy is associate degree metric. Applying the bilateral filter and Gaussian filter is used to enhance the quality of the image. The point of preprocessing is partner degree improvement of the picture data that stifles undesirable twists or upgrades some picture choices pertinent for more procedure and investigation tasks.

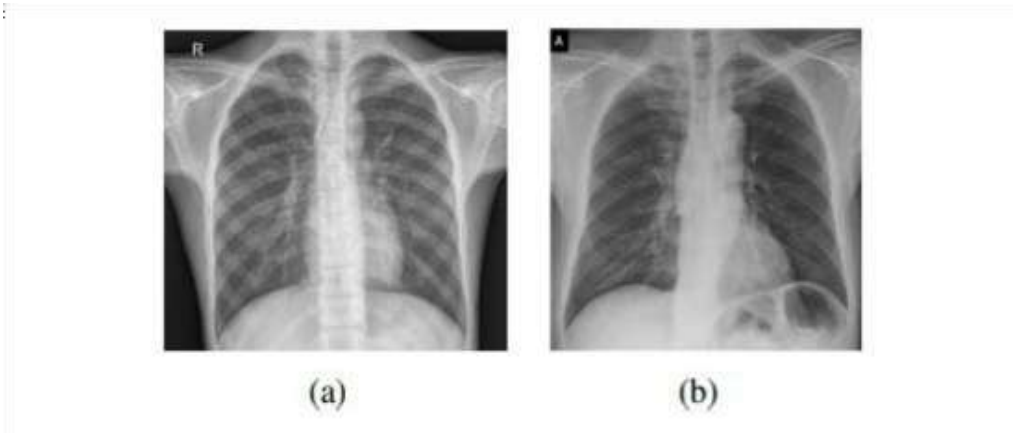
Feature extraction: - Feature Extraction expects to decrease the number of highlights in a dataset by making new features from the current ones. This new diminished arrangement of the feature should then have the option to outline most of the data contained in the first arrangement of the feature. Right now, outlined adaptation of
the first features can be made from a blend of the first set.

DWT and CNN: - Discrete Wavelet Transform (DWT) gives an ideal reconstruction of the sign upon reversal. This implies you can take the discrete wavelet transform of a flag and afterward utilize the coefficients to blend a careful generation of the sign to inside numerical precision. You can execute a reverse DWT; however, it is regularly the situation that the remaking is not great. Remaking a sign from the DWT coefficients is a considerably less steady numerical activity.

Detection: - At this stage we detect the result images with positive or negative chest x-ray images against corona.

4. RESULT ANALYSIS

While working on this project, we have used lots of X-ray images of chest with different sizes as well as with different formats. In this research paper, we have worked on two chest X-ray images one image is normal (Negative) and other is affected from a corona virus (Positive) as shown in fig. 3 it has normal resolution and size of 198 MB as well as we have gathered few low-resolution images and high-resolution images from hospitals also with different sizes with various image format like *.tiff, *.png, *.jpeg etc.



(a) Covid-19 Negative (b) Covid-19 Positive (Sample images)

Fig. No. 3: Chest X-rays of Normal and Covid Person

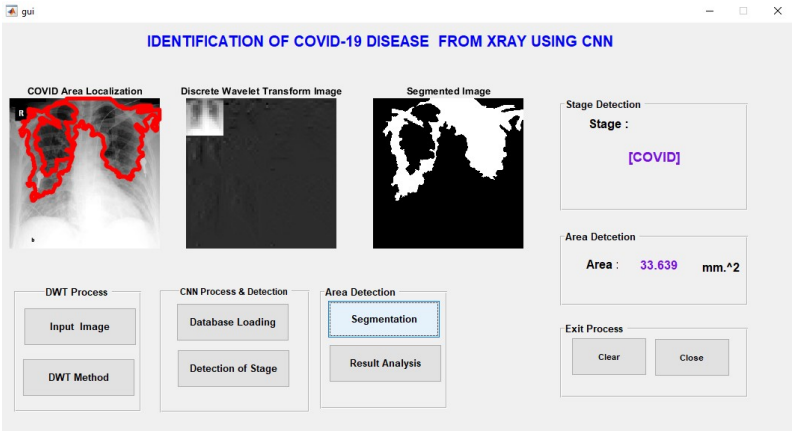


Fig no.4 GUI showing the covid result

After working on 525 images (125 COVID-19 and 400 Normal) for the analysis of the result we trained in lots of image data as well as trained these datasets which artificially increases the training samples. Figure No. 4 shows result of a patient who is affected by covid-19 virus. The Sharpened images with different image sizes and by using different architecture produced consistent results for all experimental dataset. The highest mean accuracy of Experiments obtained is 95.7%.

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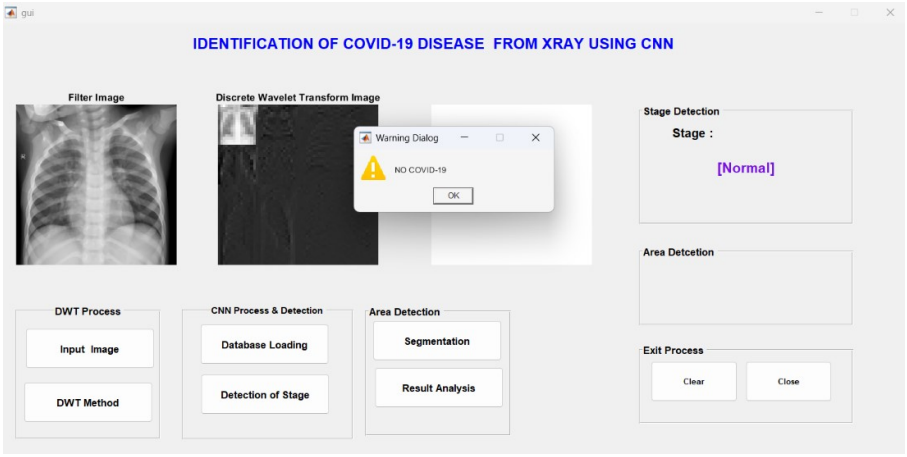

Fig no.5 GUI showing the Non-COVID result

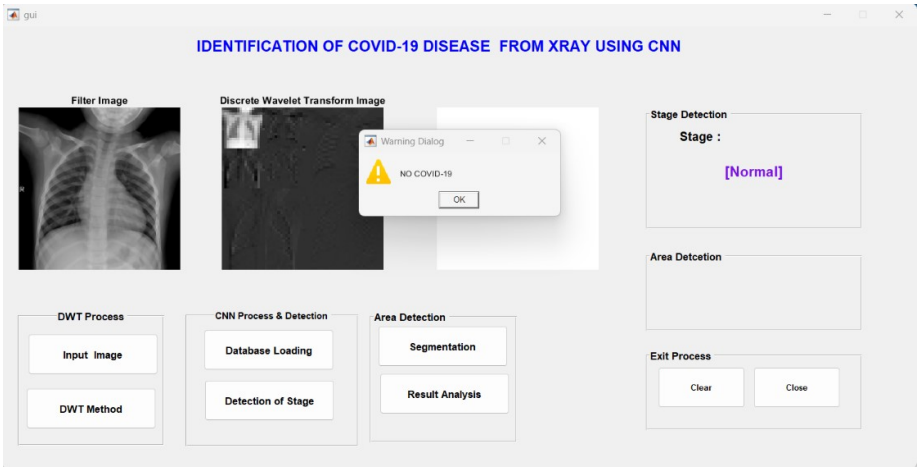

Fig no.5 GUI showing the No COVID result

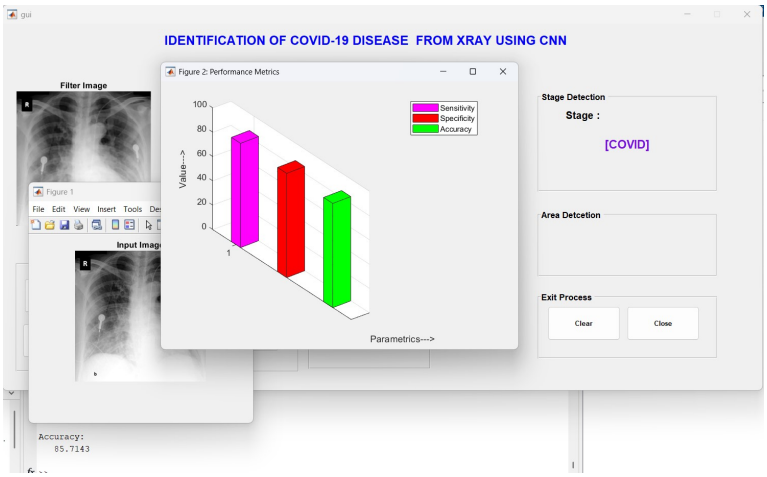

Fig no.6 GUI showing the COVID result

Sr.No.	Image Name	Result	Accuracy
1.	Image 1	Non-Covid	60.6 %
2.	Image 2	Covid	85.71 %
3.	Image 3	Covid	95.7 %

Table No. 1 Summary of result with different images

The table No. 1 shows the summarization of parameters, accuracy, sensitivity and Specificity of another model and our proposed model. It is evident from the summary that the performance of our proposed solution, is better for every type of images.

In medical applications, the model with the higher area detection score is more capable of distinguishing between patients with COVID-19 and without COVID-19. “Positive” and “negative” results are the responses of the outputs (classification predictions) obtained from the model. “True” and “false” are the actual data. The accuracy, sensitivity, and specificity are calculated as given in Equation (1), Equation (2), and Equation (3), respectively:

$$\text{Accuracy} = (TP+TN) / (TP+TN+FP+FN) \quad (1)$$

$$\text{Sensitivity} = TP / (TP + FN) \quad (2)$$

$$\text{Specificity} = TN / (TN + FP) \quad (3)$$

where TP and TN denote the true-positive and true-negative values, respectively; and FP and FN represent false-positive and false-negative values, respectively.

5. CONCLUSION

In this study, we proposed a novel Convolutional Neural Network (CNN)-based approach for the automatic identification and analysis of COVID-19 infections using chest X-rays and radiology images. The developed model demonstrates high accuracy, sensitivity, and specificity in detecting COVID-19 related abnormalities, effectively distinguishing them from other conditions such as pneumonia and normal cases. By deep learning and radiological imaging, this method provides a reliable, fast, and scalable solution to support clinical decision-making, especially in resource-limited environments where RT-PCR testing may not be widely available or timely. The integration of attention mechanisms and model explain ability tools enhances the trustworthiness and interpretability of the system, making it suitable for real-world healthcare applications. Overall, this CNN-based technique serves as a promising tool for early detection, monitoring, and triaging of COVID-19 patients. Future work will focus on improving generalization across diverse populations, incorporating multi-modal data (e.g., clinical reports), and deploying the system into clinical workflows for broader validation and adoption.

6. REFERENCES

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