# Detection and Recognition of COVID-19 CT Images

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**Abstract:**
Most of the world's countries have seen the 2019 coronavirus disease (COVID-19) spread quickly. The globe has been dealing with a global health crisis since 2019. To combat COVID-19, automated identification of lung infections is essential. It is known that the most recent coronavirus originated in the Chinese city of Wuhan. It is a novel coronavirus that poses a risk to humans and was identified for the first time in December 2019, according to the World Health Organization (WHO). The bi-branch feature fusion network topology suggested by this study is built on Transformer modules and Convolutional Neural Network modules. When using CT scans for COVID-19 classification, it performs well; the classification accuracy is 97%.

**Keywords**: Convolutional neural network, Detection, Recognition, COVID-19,

# كشف وتمييز صور الأشعة المقطعية للفيروس التاجي19-COVID

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**الخلاصة :**
شهدت غالبية دول العالم انتشار مرض فيروس كورونا 2019 (كوفيد –19) بسرعة و تعامل العالم مع أزمة صحية عالمية منذ عام 2019 من أجل مكافحة فايروس كورونا يعد التعرف الآلي على التهابات الرئة أمرًا ضروريًا للغاية من المعروف أن أحدث فيروس كورونا نشأ في مدينة ووهان الصينية. أن فيروس كورونا فايروس جديد ويشكل خطرًا على البشر وتم تحديده لأول مرة في ديسمبر 2019 ، وفقًا لمنظمة الصحة العالمية . تم أقتراح شبكة الاندماج ثنائية الفرع في هذه الدراسة وبناء وحدات المحولات ووحدات الشبكة العصبية التلافيفية. عند استخدام التصوير المقطعي المحوسب لتصنيف الفايروس التاجي تبين ان النظام يعمل بموثوقية عالية وكانت دقة التصنيف بحدود 97% .

**الكلمات المفتاحية:** الفيروس التاجي كورونا 2019،كشف، تمييز، الشبكة العصبية التلافيفية .

## 1. Introduction:

Since its discovery in Wuhan, People's Republic of China, in December 2019, the coronavirus (COVID-19) has posed a significant and continuing danger to the world's health. The deadly coronavirus has infected 255,324,963 people and killed 5,127,696 people, according to data from the WHO; a direct effect of the coronavirus on the lungs can result in sickness and even death [1]. Improved CT scan images are used with the help of ResNet 50 to categorize COVID-19 better [2]. Through a study of this research on COVID-19, a diagnosis was made using a CT image and CXR processing with deep learning [3]. As a result, an approach for automatically and accurately classifying COVID-19 utilizing pre-trained models, Convolutional Neural Networks (CNN), and CT lung images, the Sparrow Search Algorithm (SSA) was proposed. [4]. In this study, a deep learning-based approach to identify COVID-19 disease from CT scans is proposed. There is no feature extraction phase in the automated model. The wavelet used to pool the feature maps, the Mish activation function, mini-batch normalization, and SE-blocks are the proposed model's four novel advances. The model was trained and tested using the datasets of two public hospitals in order to be evaluated [5]. COVID-19 positive and negative CT scan image preprocessing and categorization using a new approach are presented in this research. The method that is being suggested preprocesses the image using the idea of wavelet empirical

transformation, choosing the best elements from the red, green, and blue channels and then training the proposed network with those components. [6] This article provides a description of the deep learning technique used for rapid COVID-19 illness detection and classification. Support Vector Machine (SVM) and Histogram of Oriented Gradients (HOG) were used to extract features, while Convolutional Neural Network (CNN) and HOG were used to classify the data. [7]. A suggestion of a hybrid strategy based on two phases is presented in this study. The feature extraction procedure, which uses PHOG, Fourier, Gabor, and DCT, comes first. The second step involves classifying the images using deep learning. The COVID 19 X-ray images are used to train and evaluate the suggested approach. [8]. This study used a modified DeTraC deep CNN architecture to classify COVID-19 images from an extensive collection of CXR images. DeTraC uses a class decomposition approach. DeTraC demonstrated efficient and reliable methods for categorizing COVID-19 cases, as well as its capacity to deal with data irregularity and the dearth of training images [9]. In order to construct a three-channel image representation that offers distinct information on each channel, this work suggests a unique image preprocessing technique for grayscale medical images that combines Contrast Limited Adaptive Histogram Equalization (CLAHE) and Histogram Equalization (HE) [10]. In this work, CT scans of the respiratory system are processed to distinguish between infected and non-infected individuals. Algorithms for deep learning binary classification have been used [11]. Chest X-ray pictures can be recognized on two levels by using a Machine Learning (ML) model, which is a novel method. The raised system automatically classifies the COVID-19-infected chest X-RAY image using machine learning models [12]. By using deep learning algorithms to extract features from chest CT-coronavirus imaging, this research discusses artificial intelligence and computer science for early medical diagnosis, which enables medical diagnoses to be made at an early stage [13]. This study offers a resolution to the world issue. Deep neural networks, a significant machine learning technique, were used to solve the problem, showing an excellent level of achievement in the medical field. The used deep network is ResNet50. [14].

**2. Proposed method:**

In order to improve performance, the goal of this work is to create an automatic model for COVID-19 Pneumonia segmenting and classifying lesions from CT scan images. Fig (1) depicts our model's system architecture diagram. Input X-RAY chest images, preprocessing and filtering, segmentation, feature extraction, and classification using CNN are some of the five modules that make up the model. Here are some CT scan images of COVID-19 patients as a dataset.

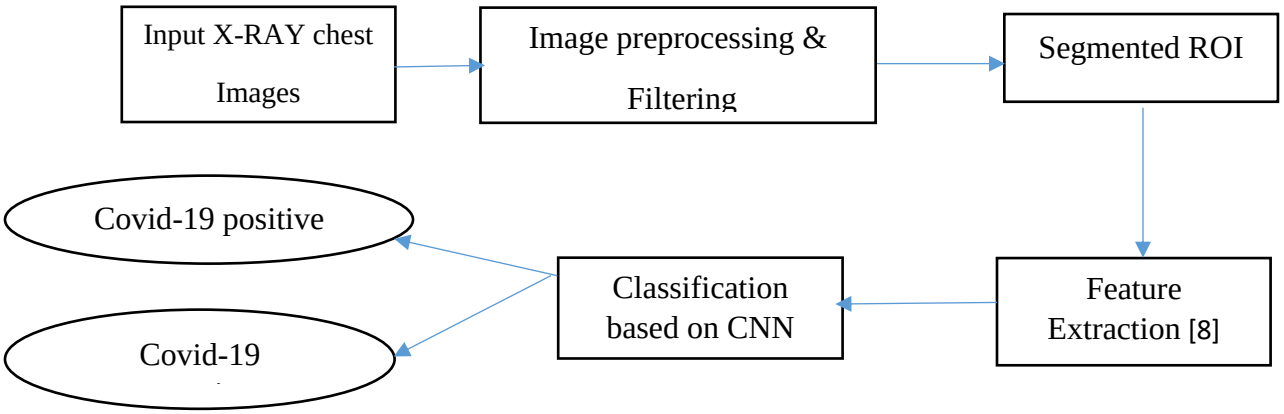
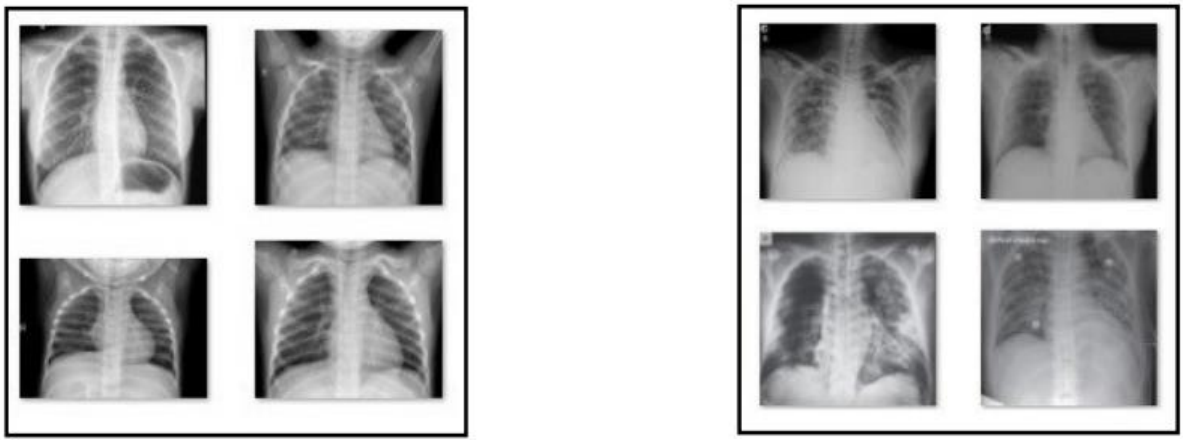



**Figure (1) :** the system architecture diagram

### 2.1. Dataset Collection and preprocessing

The suggested system's initial phase involves collecting a dataset of COVID-19 chest X-ray images from three sources: The Kaggle Chest X-rays [15], the GitHub open source repository that Cohen introduced [16], and others The dataset includes 37 COVID-19 examples, 500 COVID-19 cases from GitHub [17] and 565 typical Kaggle examples [15]. There were a total of 1102 chest X-ray images that were gathered. Figures (2 a & b) show the two categories of the COVID-19 raw dataset, which is a collection of X-ray images in JPG format with a 24-bit depth and different sizes.



a b

**Figure (2) :** (a) Negative (uninfected) and (b) Positive (infected) cases from the COVID-19 chest X-ray image collection

Preprocessing seeks to enhance the image data by removing undesired distortions or strengthening specific visual characteristics crucial for later processing and analysis tasks. The preprocessing part of this study involves using Matlab to convert color images to grayscale, scaling the images, and applying different types of filters, like a Gaussian filter with a size of (7, 7). With the use of the Fourier transform, the smoothed image is more affected by nearby pixels than by pixels farther away. Following feature extraction from segmented images using the CNN's Convolution layer, a CNN-based classifier is used to determine whether the image is COVID or normal. In terms of extracting image features, convolutional neural networks have demonstrated significant benefits. The structure of CNN itself determines how successfully it extracts image characteristics with clear local features. CNN's regional coverage area, a network topology made up of a convolution kernel, is its most noticeable characteristic. The processed image, on the other hand, is a CT image used to identify COVID-19, and its medical characteristics include clear local lesion features and dispersed overall features. Due to the specificity of the data used in this study, the Transformer module is used to extract the global features of CT images and combine them to improve classification results. In order to extract characteristics from COVID-19 CT images, this study suggests a categorization model based on Transformer and Convolutional Neural Network modules. These are the precise steps.

1) The Transformer branch module processes the COVID-19 CT image, and as a result of the image's global receptive field properties, the image's global features are extracted.

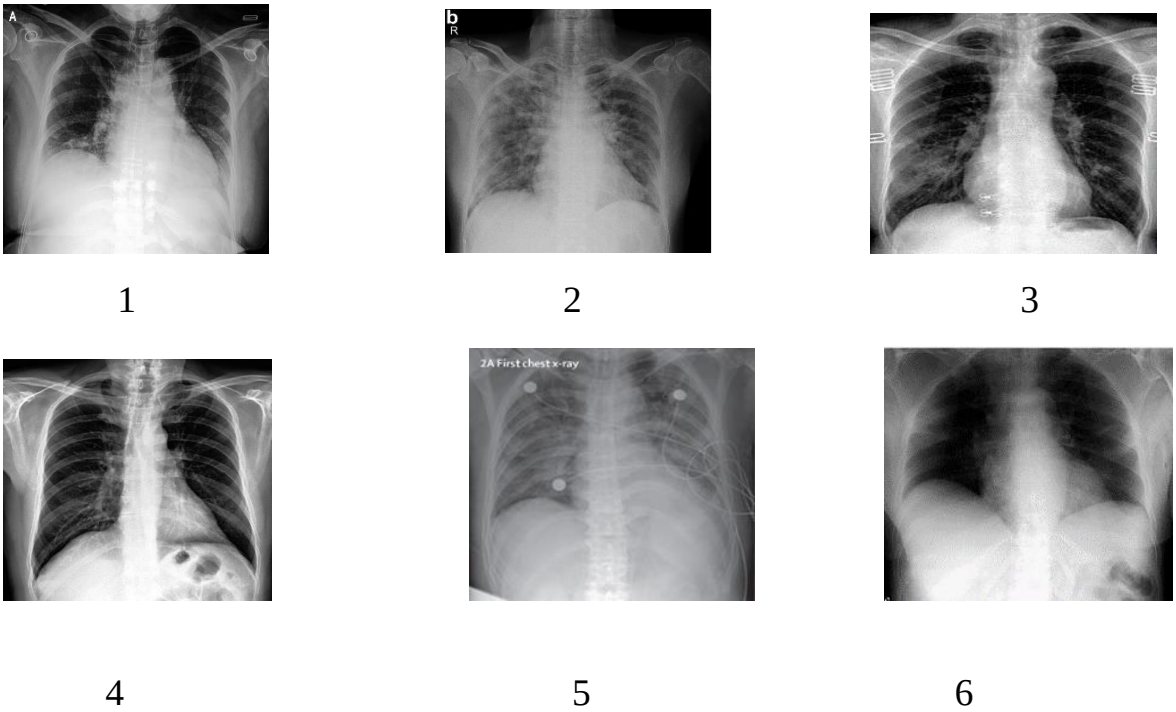
2) A convolutional neural network branch module processes the COVID-19 CT image, and local features are retrieved using convolutional local receptive field features.

3) Making a bi-directional feature fusion structure between the two branches allows the two branches' properties to be combined. Because the feature fusion, in this case, is bi-directional, it can extract richer, more complete features and increase the classification accuracy.

4) Once the loss is determined, the inverse gradient computation is done, and when the classification vectors obtained from the two branches are fused, the model parameters are modified.

**3. Experimental Results and Discussion**

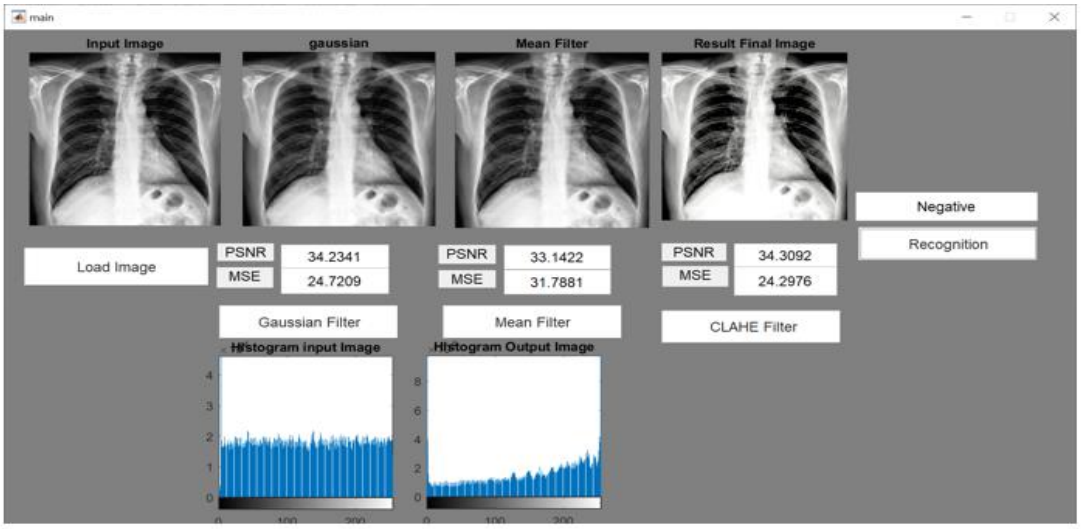
ConvNets are one of the deep learning techniques used in this area of research for object recognition, detection, and classification in images. The convolution layer, pooling layer, and fully linked layer make up the fundamental components of the ConvNet architecture. There are no duplicates or modified versions of any images downloaded from Google. Chest X-ray images from the COVID-19 dataset were gathered pre-processed, and the dataset was then enlarged using data augmentation and histogram equalization. Then, CNN architecture was developed and taught to distinguish between infected and uninfected cell images. The image to be examined (shown in Fig 3) is uploaded. Then, the noise level is reduced using Gaussian filters and the mean filter, as illustrated in the graphical user interface GUI built using Matlab in Figure (4a & b). Contrastive Limited Adaptive Histogram Equalization (CLAHE), one of the best methods for improving x-ray images, has been used. A determination is made on the case's coronavirus infection status based on the previously used detection and recognition process, as displayed in the GUI.



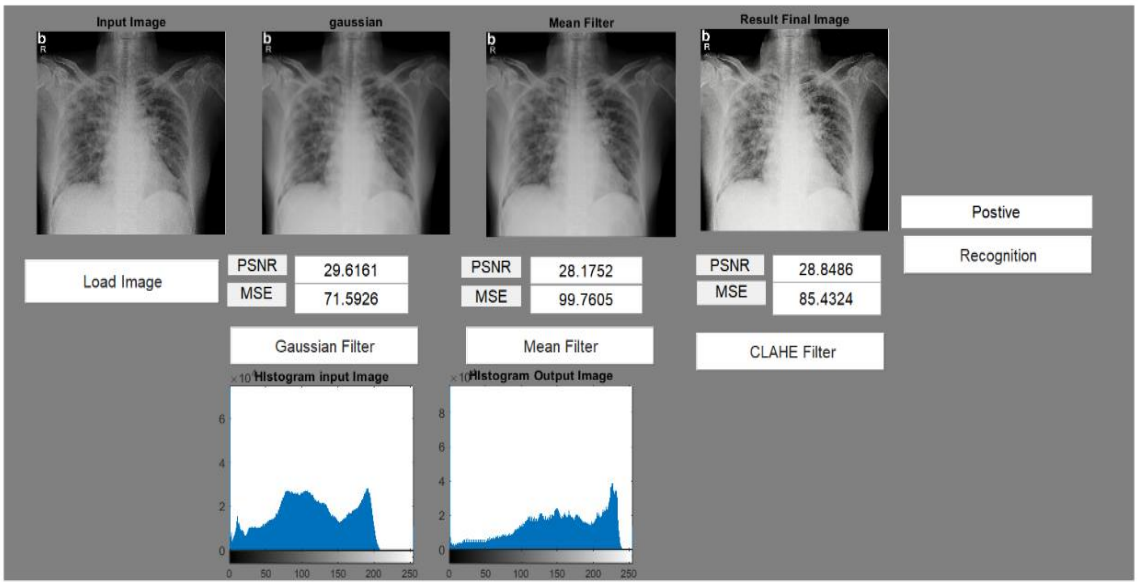

1 2 3

4 5 6

**Figure (3) :** Sample of x-ray images




(a)




(b)

**Figure (4) :** GUI for detecting and identifying COVID-19 (a) Negative for COVID-19 (b) Positive for COVID-19

## 4. Conclusion

In order to train our model to detect the presence of COVID-19 on the X-ray images, we processed the collection of images to make them pass to a light CNN architecture using the histogram equalization technique for an intensity distribution in the images. This study allowed us to develop a new medical image processing method for detecting COVID-19 from chest X-ray images. A bi-branch feature fusion network topology is suggested based on Transformer and Convolutional Neural Network modules. Utilizing the benefits of both branches' local and global features, they are fused bi-directionally in the fusion layer to extract the features of CT images. This procedure allows the network to process data in parallel, speed up network operation, and produce better classification results. The approach can extract local and global features and has an excellent capacity for generalization. It does well, with a classification accuracy of 97% when using CT images to classify COVID-19. In conclusion, this study has significant implications for the classification of medical images.

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