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Article Title: Convolutional Neural Network-Based Approach for Automated Diagnosis of COVID in Chest X-Ray Images

Convolutional Neural Network-Based Approach for Automated Diagnosis of COVID in Chest X-Ray Images

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ABSTRACT

Coronavirus is acute viral disease that can induce respiratory failure due to extensive alveolar damage, perhaps leading to deafness. This paper proposes a COVID detection using CNN in chest X-ray images. To preprocess the input image, an adaptive wiener filter is utilised. This preprocessing technique is utilized to removing the noise from the image. After pre-processing, the noise removed image is fed into the segmentation block for segmenting the image into several segments for further process. The processed image is further segmented by the fuzzy C-means segmentation. The segmented image is classified by an effective classifier. CNN is used for classification. Final output will predict by using Convolutional Neural Network classifier. This paper is implemented with MATLAB.

Keywords: COVID detection, Adaptive wiener filter, Fuzzy C means (FCM) Convolutional neural network (CNN).

1 Introduction

COVID-19 changed the direction of human history. It has not only killed millions of people, but it has also dramatically transformed the world's economic, political, and social circumstances [1]. The World Health Organisation (WHO) recently designated a new worldwide epidemic, coronavirus disease 2019 (COVID19) [2]. In COVID-19 epidemic,

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health monitoring technology was vital. According to the World Health Organisation, COVID19 has afflicted over 579 million people, with six million deaths documented as of August 8, 2022 [3]. COVID-19 pathophysiology implies that infection causes the SARS-CoV-2 virus to grow and travel down the respiratory tract to the epithelial cells of the lungs [4]. Because it is faster and less expensive than CT, COVID-19 detection in chest X-ray (CXR) pictures is favoured for accurate diagnosis, evaluation, and therapy [5]. Social isolation is the most effective non-pharmaceutical technique of preventing the transmission of COVID-19. Big data, artificial intelligence, and other technical breakthroughs have aided in social distancing monitoring because to their rapid development. Methods for determining social separation that have been used in the past [6]. COVID-19 patients frequently have respiratory difficulties as well as an increase in body temperature. There may be some asymptomatic infected people in the population during the coronavirus incubation phase, which speeds up transmission. If infected, this virus would be extremely dangerous to people's health and safety. As a result, rapid and precise identification and isolation of afflicted individuals are important to avoiding and mitigating epidemic transmission [7]. Furthermore, prevalence surveys undertaken in a variety of countries show that after being exposed to the virus, only a small proportion of the population generated antibodies. This suggests that there will be a huge number of patients. may frequently require rapid evaluation by a small number of professionals with limited resources [8]. Patients who become infected frequently have the following symptoms: taste/small loss, fever, cough and shortness of breath [9]. Due to the significant risk of false negatives in RT-PCR, CT scans can be employed as one of the key diagnostic options for COVID-19 illness detection. Indeed, researchers are well aware that the low sensitivity of RT-PCR detection cannot be allowed in extreme instances like the current outbreak, because an undiscovered ill person can spread the virus to healthy people [10].

Hence the accuracy of the present techniques has to be improved for effective treatments. In this paper proposed a COVID detection using Convolutional Neural Network in chest X-ray images. The list below demonstrates how the paper is organised: Section II describes the most recent work. Section III describes the suggested work in detail. The outcomes are presented in Section IV. Section V provides a conclusion.

2 Recent Works

Alaa A. R. Alsaeedy *et al* (2020) [11] have developed existing cellular-network functions for managing end-user mobility and ensuring seamless coverage. This method identifies at-risk locations by leveraging current cellular network capabilities such as cell (re)selection and handover and, which are used to keep mobile end-user equipment (UE) covered smoothly.

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These metrics, acquired from a vast number of UEs, enable us to pinpoint high-risk regions while protecting individuals' privacy and anonymity.

Xi Ouyang *et al* (2020) [12] have presented a unique online attention module using a 3D CNN is used to concentrate on the lungs' infection hotspots. To the best of our knowledge, this technique is based on the largest multi-center CT data set for COVID-19 from 8 institutions. This approach helps radiologists diagnose COVID-19 from CAP, especially in the early stages of the COVID-19 outbreak. Visual proof, however, is insufficient to make an overall correct prognosis.

Shaoping Hu *et al* (2020) [13] have examined a Detection and classification of COVID-19 infection from CT scans using a weakly supervised deep learning technique. Detecting and classifying COVID-19 infection from CT scans using a weakly supervised deep learning technique. This method eliminates the requirement for manual CT image tagging while still detecting infections and separating COVID-19 cases from non-COVID-19 cases. Conv3 is unable to detect larger patchy-like lesions, which could be related to a smaller receptive field at the mid-layer.

Xinggang Wang *et al* (2020) [14] have proposed a Weakly-supervised COVID-19 Identification and Lesion Mapping from Chest CT. Without the necessity for labelling the lesions for training, in chest CT, a weakly-supervised deep learning network is accurately estimate COVID-19 infection likelihood and locate lesion regions. However, because computations were not shared across slices, it had a substantially greater computation cost than our DeCoVNet.

Julián D. Arias-Londoño *et al* (2020) [15] have suggested an examination of several methodologies based on a DNN. These are the initial steps towards creating a computerized COVID-19 diagnosis tool that uses chest X-ray images to differentiate between control, pneumonia, and COVID-19 groups. The paper contributes the body of knowledge by proving deep learning techniques' capacity to effectively categorise XR images. Several datasets, however, reveal reduced variability for specific classes (variability in terms of scattering).

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3 Proposed Work

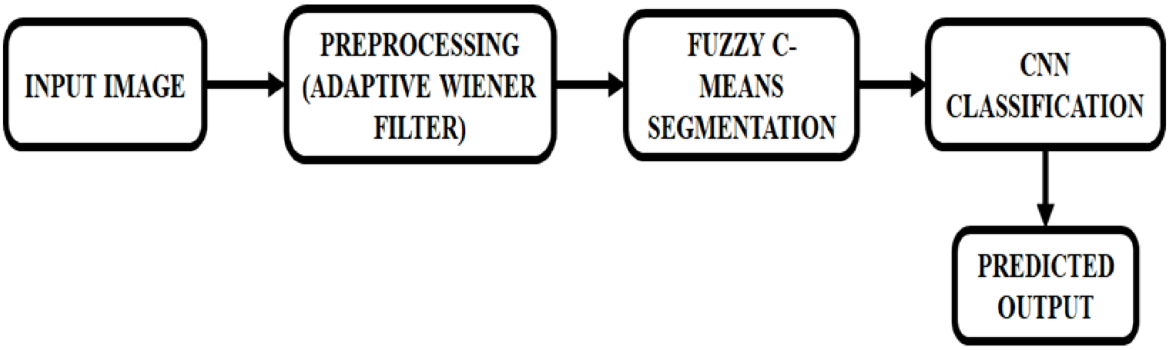

Figure 1: *Block Diagram for Proposed System*

COVID detection in chest X-ray pictures is presented in this proposed work employing Convolutional Neural Network. The input image is pre-processed with an Adaptive Wiener filter to reduce noise. Following pre-processing, the noise-free image is fed into the segmentation block, which separates it into multiple segments for further processing. For segmentation, the fuzzy-c-means clustering algorithm is utilised in this process, which separates the incoming image into 256 samples. Finally, the selected features are sent into the CNN classifier, which appropriately classifies the image. When compared to other classifiers, the quantitative accuracy of the categorised image is higher. Finally, predict the outcome after classification.

3.1 Preprocessing

Pre-processing aims to improve the image's quality so that it can be studied more effectively. Remove unwanted distortions and enhance key application functionality through preprocessing.

3.2 Adaptive wiener filter

In the preprocessing phase, an adaptive weiner filter is applied. This filter modifies the output based on the image's local variance. Its ultimate purpose is to minimise the mean square error between the restored and original images.

3.3 Image Segmentation

Depending on the pixels in the image, image segmentation is a technique used in computational image processing and evaluation to divide an image into various segments or zones.

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3.4 Fuzzy c means

A popular image segmentation algorithm is the fuzzy c-mean algorithm, which separates the image space into various cluster regions with similar image pixel values. For medical picture segmentation, fuzzy clustering is the optimum clustering type.

3.5 Convolutional Neural Networks

CNN is a deep learning method used in a variety of practical applications. CNNs may be taught to consistently classify images, detect features in images, and even anticipate the following word in a phrase. Rather of manually interpreting MRI pictures, a CNN-based system will aid medical practitioners in their therapeutic function by speeding up the healing process. Face recognition, picture categorization, and other computer vision applications are examples of CNN applications. It resembles a simple neural network. Weights and biases are examples of properties of CNN that can be taught. CNNs produce detailed findings despite their complexity in terms of resources and expertise. Everything centres around recognizing patterns and nuances that are so minute and undetectable to the human eye that they are overlooked.

3.5.1 Classification of CNN

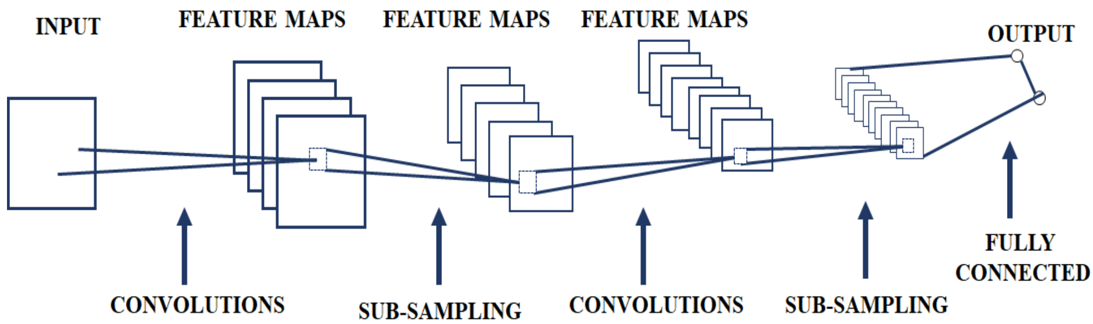

Figure 2: *CNN architecture diagram*

A neural network's layers are linked by nodes or neurons that take input data and process it through the network's layers to produce an output:

- The network's first layer, the input layer, is where input data is transmitted. The input layer merely receives data and transfers it to the next layer; it doesn't do any computations.
- The output layer appears before the hidden layers, which follow the input layer. These tiers handle the majority of the network's computation, including feature extraction and abstraction.

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- The outcome of the layer is the network's final layer and is responsible for generating the network's output.

3.5.2 Working of CNN

CNNs are constructed from interrelated components that process input data. A convolutional layer, which applies a sequence of filters to the input data to recognize particular patterns, is frequently the first hidden layer in a CNN. By sliding across the input data and conducting element-wise multiplication with the filters' contents, each filter creates a feature map. After that, using non-linear activation methods like the ReLU function, which introduce irregularities into the model and enable it to learn more intricate patterns in the data, the feature maps are aggregated and routed.
Additional convolutional layers, pooling layers, and fully-connected layers are examples of subsequent layers in a CNN. The size of the feature maps is decreased by pooling the layers. The model has fewer parameters, which increases its computational efficiency. The convolutional and pooling layers are usually followed by the fully-connected layers of a CNN. All of the neurons in one layer are connected to all of the neurons in the next layer via a fully-connected layer, which enables the model to develop non-linear combinations based on the convolutional layers' learned features.
A softmax layer, which creates a probability distribution for the candidate class labels in the input data, is frequently the final layer of a CNN. The forecast of the model is chosen to be the class with the highest likelihood.

4 Results and Discussion

4.1 Input

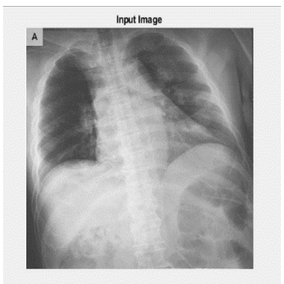

Figure 3: *Input Image*

Figure 3 Shows Input image. These images are further used for preprocessing.

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4.2 Pre-Processing Image

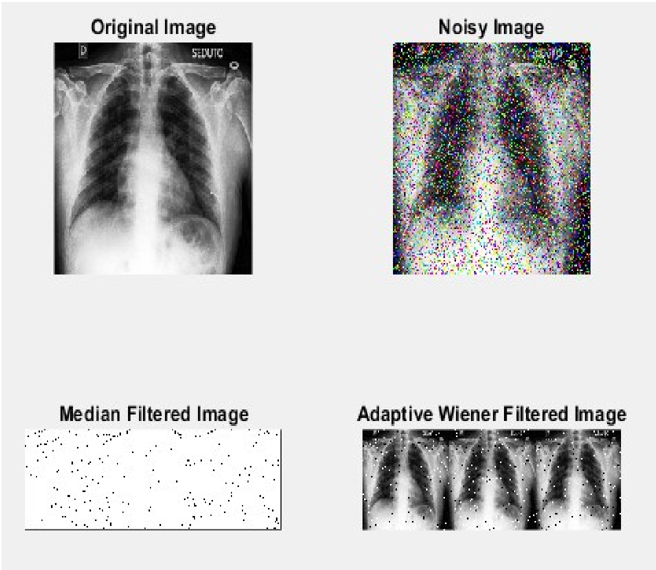

Figure 4 Preprocessed image

Figure 4 represents that preprocessed image. For preprocessing, the Adaptive Wiener Filter is used. With higher frequencies, it blurs the intended area and cuts the noise. It functions similarly to mean filters while representing average weight equally.

4.3 Segmented Image

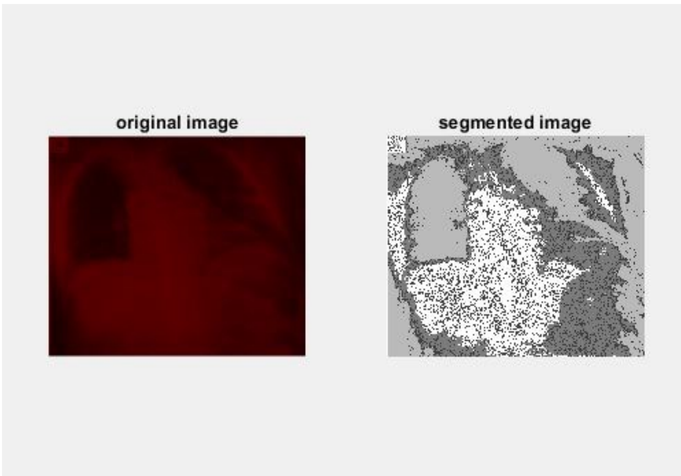

Figure 5: *Segmented image*

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Segmented image is represented in figure 5. In fuzzy c means segmentation the image is accomplished by splitting the image space into multiple cluster sections with similar image pixel values.

4.4 Classification

Figure 6: *Classifier-CNN*

Output is displayed in Figure 6. The output is predicted by using CNN classifier.

5 Conclusion

Recognizing COVID as the cause of pneumonia rather than other viruses or bacteria is crucial in clinical practise in the present pandemic environment because it alters treatment strategy. The suggested method meets this requirement by separating COVID positive scenarios from NCP cases. The attribution pattern that develops in this work might be considered as a validation of this distinction. This pattern difference is compatible with clinical literature criteria, which is appealing and vital for gaining trust in CAD remedies. The goal of this COVID-19 detection model was to show that an accurate diagnosis of COVID-19 can be made using CNN trained on chest X-ray image datasets. The model was gradually trained using several datasets to get the maximum accuracy and performance. Adaptive Weiner filter is used to preprocess the input image. This preprocessing technique is used to remove distortion from images. Following pre-processing, the image with the distortion detached is provided into the segmentation block, which divides the image into many segments for further processing. The processed image is further segmented by the fuzzy C-means segmentation. CNN is used for classification. Final output will predict by using Convolutional Neural Network classifier.

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