



Smart access development for classifying lung disease with chest x-ray images using deep learning

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ABSTRACT

Recently the world has come across a pandemic disease known as covid-19. The presence of symptoms of covid-19 and pneumonia may be alike to other types of lung illnesses. So, because of this, it is difficult for the affected person or medical experts to identify the condition. Chest x-ray provides general orientation which can be an initial investigative study in the analysis of lung diseases. Information from retinogram studies help the finding of covid-19 and pneumonia affecting the lungs. We use a Convolution Neural Network (CNN) in Tensor Flow and Keras based covid-19, pneumonia classification. The best fit model of CNN is then deployed in the Django framework for providing a better user interface and predicting the output.

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1. Introduction

The planet has encountered a dangerous disease is understood because the covid-19, which is caused by SARS-COV-2 virus [1]. Most of the people infected with this disease experience mild to a severe respiratory illness which couldn't be cured with treatment[2]. Another well-known disease is pneumonia which is caused by inflammation of the lungs. This disease could affect the alveolar and surrounding tissue of the lung and also results in severe breathing problems[3]. During this pandemic situation, it's difficult to diagnose between covid-19 and pneumonia as it has similar symptoms such as fever, chills, cough, and pain. So smart access is developed using deep learning[4].

1.1. Deep learning (DL)

- Machine learning works with huge amounts of structured data, whereas, deep learning works with both structured and unstructured data.
- Deep learning can perform complex operations.
- To achieve the best performance with a large amount of data we require deep learning.

- Machine learning extracts patterns based on labeled sample data while deep learning takes a large amount of input and analysis to extract features out of an image/object[5].

1.2. Merits of deep learning

- Features are automatically deduced and tuned for the desired output. This reduces the time for computation.
- The same neural network-based can be applied to various other applications and data types.
- It is flexible to be adapted to new problems in the future[6].

1.3. Demerits of deep learning

- They take a large amount of data and time to train the model.
- Training and choosing the right topology of the model is a black art.
- They are inscrutable[7].

2. Software requirement

- Operating system: Windows/Linux.
- Simulation tool: Anaconda navigator with jupyter notebook.
- Web development: Pycharm.

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Anaconda navigator - Anaconda Navigator grants clients to dispatch applications, and ought to oversee anaconda bundles, environments, and channels without utilizing command-line commands [8].

Jupyter Notebook - It is an open-source network authorized to make and part exercises that contain live code, conditions, picturing, and description content [9].

Pycharm - PyCharm is an integrated advancement environment (IDE) utilized in programming (python dialect). It supports web improvement with Django additionally with Anaconda[10].

3. Methodology

3.1. The collection of the dataset

Upper body x-ray dataset for covid-19, pneumonia, and ordinary has been collected [11,12]. Sometimes passing on to the CNN demonstrate for preparing the information is pre-processed with the implies of subtraction and some of the time normalization.

Chest x-ray images.

Chest x-ray record could be an exceptionally prevalent database, Dataset is systematized into 2 envelopes (prepare, exam) and both prepare and trial comprise subfolders (covid19, pneumonia, normal). The record contains an add- up to 6432 x-ray images, and examination information has 20% of the entire pictures. Preparing subfolder has covid-19 460 pictures, pneumonia 3418 pictures, and typical 1266 pictures. Testing subfolder has covid-19 116 pictures, pneumonia 855 pictures, and typical 317 pictures. The Fig. 1 show the sample of dataset.

3.2. Convolution neural network model selection

Four diverse CNN models were prepared, approved, and tried to this extend. Assessment of CNN, two-layer CNN AlexNet CNN, and LeNet CNN were performed utilizing python on an anaconda navigator with jupyter notebook Three comparative models (CNN, AlexNet CNN, and LeNet CNN) and one test show (two-layer CNN) were assessed to explore whether they are appropriate for web advancement.

Investigation of deep layer features

The preparing dataset is utilized to prepare the demonstrate (CNN) so that it can recognize the test picture and the infection it has. CNN has diverse layers they are within the following

- Conv2D: It is the layer to convoluted the picture into different pictures, actuation is the enactment work.
- MaxPooling2D: It is utilized to max pool the esteem from the given measure framework and the same is utilized for the following 2 layers.
- Flatten: straighten the measurements of the picture gotten after convolution.
- Dense: It is the hidden layer.
- Dropout: Dodge over fitting on the data set.
- Image Data Generator: Image Data Generator incorporates all conceivable introductions of the picture.

- Epochs: It tells us the number of times the demonstrate will be prepared within the forward and in reverse pass.
- Validation process: approval information is utilized for the validation/test information into the model.

3.3. Performance evaluation matrix

The execution of distinctive systems was assessed utilizing five execution measurements such as- exactness, affectability, specificity, accuracy, and F1 score.

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + TN + FP}$$

$$\text{Precision} = \frac{TP}{TP + FP}$$

$$\text{Recall} = \frac{TP}{TP + FN}$$

$$\text{F1score} = \frac{2 \times \text{precision} \times \text{recall}}{\text{precision} + \text{recall}}$$

$$\text{Specificity} = \frac{TN}{TN + FP}$$

3.4. Development of web application

The leading fit CNN show is changed over to progressive arrange to deploy an AI demonstrate with Django system to form a web server utilizing PyCharm program. User can transfer their chest x-ray picture to course the lung disease(covid-19/pneumonia/normal). Fig. 2 shows the block diagram of proposed system.

Fig. 2 Block diagram of the proposed system.

4. Results

We have effectively illustrated the potential of utilizing DL calculations in evaluating CXRs for covid-19, pneumonia, and normal. Convolution neural arrange to demonstrate is superior to other feed-forward neural systems because it has superior exactness of 93.3% moreover, the computational control is lessening since dimensional decrease and parameter sharing. To decrease the misfortune esteem of the convolution model, the convolution layer is further included and inspected. Three diverse CNN-based models are taken are prepared and tested for superior exactness and less blunder.

The execution of prepared models was assessed utilizing a confusion network and a graph. Firstly, the exactness and loss values within the training process gotten for the models. The center distinction is that the accuracy of training is based on the images that the network can learn, so the network can over adapt to the clamour within the information whereas loss gives a locate into how well the method of learning is progressing, lower numbers are way better the show. From the table 1, it is obvious that the execution of the AlexNet demonstrate is

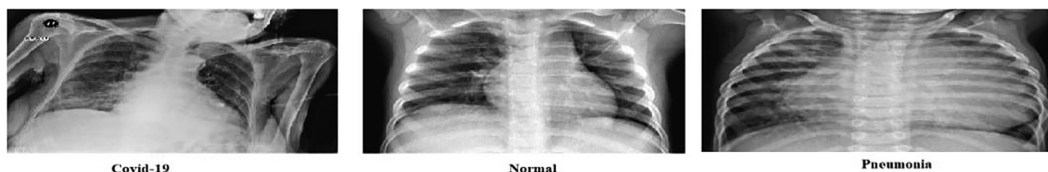


Fig. 1. Sample of chest x-ray dataset.

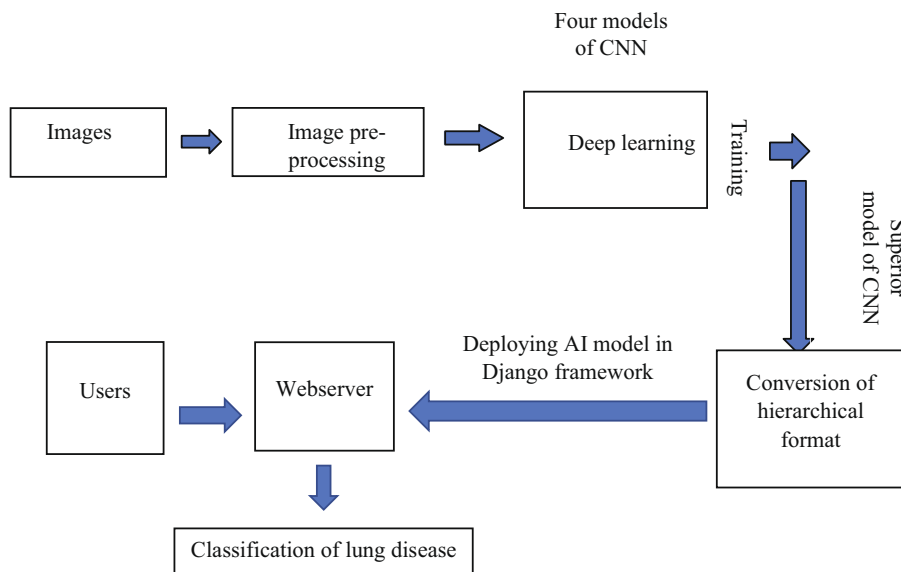


Fig. 2. Block diagram of the proposed system.

Table 1

Performance comparison of CNN models.

MODELS	ACCURACY(%)	LOSS	PRECISION	SENSITIVITY	F1 SCORE	SPECIFICITY
CNN	93.3	0.213	0.93	0.93	0.93	86
TWO LAYER CNN	93.4	0.197	0.93	0.93	0.93	82
ALEXNET CNN	94.7	0.153	0.94	0.94	0.94	66
LENET CNN	93.2	0.174	0.93	0.93	0.93	88

superior to the other models. It can be said that the AlexNet demonstrate comes to lower values among the loss values of other models. The AlexNet model shows up to have less wavering after the 50th epoch. As seen from Table the AlexNet show in the classification of lung illness is altogether higher than the other models. AlexNet has the most elevated in general execution with 94.7% and a loss of 0.153. This demonstrates

performed exceptionally well with 0.94 precision, 0.94 affectabilities, 0.94 F1 score, and 66 specificities.

Utilizing the prepared DL demonstrate (shown in Fig. 3), we continued to form a web application that may increase lung illness determination. The site works on the desktop stage. One can take a CXR photo with a portable phone or transfer it from the record. The DL calculation would give the likelihood of covid-19, pneumonia,

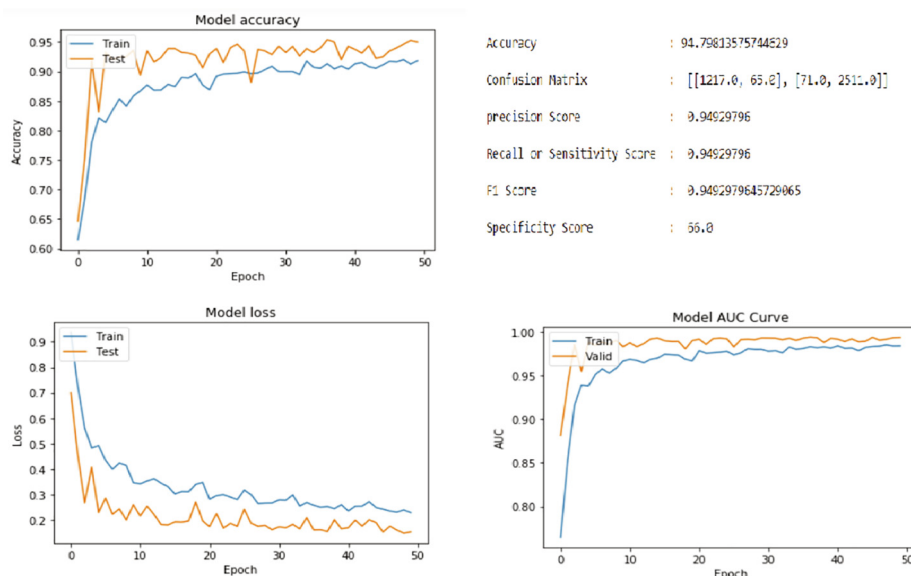


Fig. 3. Performance graph and confusion matrix for AlexNet CNN (the best fit model).

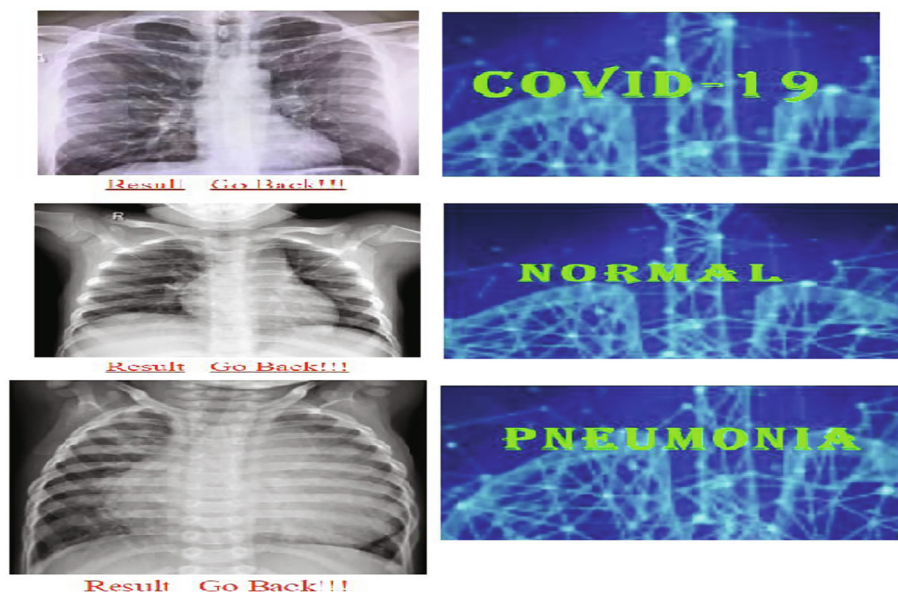


Fig. 4. Results obtained from the web application.

or a normal lung X-ray conclusion. The Fig. 4 shows the results obtained from web application.

5. Conclusion

This work involves a basic convolution semantic network-based exchange learning conspire for altered divulgence of covid-19, pneumonia, and normal. Four distinctive CNN-based models were skilled, authenticated, and confirmed for categorizing required respiratory contamination utilizing torso roentgenogram pictures. It was observed that AlexNet CNN beats other particular significant convolutional models. In this work, a tremendous dataset observed that significant frameworks perform predominantly to shallow systems.

Covid-19 has directly wrapped up the dangers to the prosperity organization and economy and thousands of individuals have as of directly passed on. Along these lines, an outsized number of influenced parts attending to out-door otherwise emergency, wellbeing center time is confined and processor-assisted assurance saves lives by essential broadcast and appropriate-maintenance. Fake insights show an astounding execution in classification since the organization is ready from an outsized dataset. We concede that this symptomatic device can inside and out move forward the speed and precision inside the appearing corona of positive cases which would be important in this pandemic.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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