Pneumonia Detection Using Deep Learning

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Abstract. Pneumonia is a life-threatening disease that affects the lungs in humans. Pneumonia is caused by Streptococcus pneumoniae bacterium. In pneumonia detection chest X-ray images are used as input dataset. To detect pneumonia chest X-rays need to be estimated by expert radiotherapists and it is expensive process, It would be beneficial and easy for people to use automatic system for pneumonia identification. People identify pneumonia using automatic system and get active treatment at early stages. The dataset containing chest X-ray images is obtained from Kaggle. The image characteristics are learned using pre-trained CNN(Convolutional Neural Network) models. CNN is used to analyse image features. This approach assists physicians in determining whether the patient has pneumonia or not. Early detection helps in early diagnosis.

1   Introduction

Pneumonia, an interstitial lung disease caused by the bacterium pneumoniae. According to WHO survey one in three in India are dead due to pneumonia. The diagnosis for pneumonia can be made quick using pneumonia detection system. An X-ray image will help the doctor to determine whether the patient is affected by pneumonia or not.

When conducting x-ray exams, radiologists search for white spots in the lungs which indicate an infection. Detecting pneumonia quickly and accurately is crucial for providing appropriate treatment and care to vulnerable areas. Chest X-ray are considered the most effective means of identifying the were assessed for their performance in categorizing abnormal and normal chest x-rays.

Computer-assisted diagnostic (CAD) system play an important role in diagnosing pneumonia by analyzing chest x-ray images. Relevant features from images that can be extracted in image classification tasks by using Deep learning mechanisms such as Convolution Neural Networks.

2 Literature Survey

EL. Khalid , Asnaoui, [1] Different types of single and ensemble learning models were utilized to classify pneumonia. Ensemble learning involves combining multiple models into a single model to tackle a specific task, with the choice of models being determined by the requirements and characteristics of the problem at hand. Currently, ensemble models are

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commonly employed for making predictions, including classification and regression tasks. By training a single model independently within an ensemble, improved accuracy can be achieved. In particular, an ensemble of three models demonstrated higher accuracy in this study.

T. Rahman, E.H. Muhammad , [2] used digital x-ray images to detect the bacterial and viral pneumonia. Four different pre-trained deep Convolutional Neural Networks (CNN): AlexNet, ResNet18, DenseNet201, and SqueezeNet were used for transfer learning. This proposed study can be useful in quickly diagnosing pneumonia by the radiologist .

P. Pratik, Hemprasad Patil, [3] Early detection and prompt treatment can significantly reduce the mortality rate associated with this disease. Chest x-rays are commonly employed to identify the symptoms of the disease. In this study, a CNN-based model was utilized to automatically detect crucial features, as opposed to using hand-engineered feature selection techniques.

Wasif Khan, Nazar Zaki , [4] This helps practitioners to select the most effective and efficient methods from a real-time perspective, review the available datasets, and understand the results obtained in this domain. The usability, goodness aspects, and computational complexity of the algorithms used for intelligent pneumonia identification are examined in this research.

S. Hossain, Rafeed Rahman, [5] The study presented a pneumonia detection approach utilizing MobileNet and ResNet architectures along with Long Term Short Memory (LSTM). This research aims to simplify image analysis for both experts and non-professionals by proposing a deep learning-based method for pneumonia detection from X-ray images. A dataset containing 5856 X-ray images was utilized, and the maximum accuracy achieved by the proposed LSTM model was noted as 90.2%.

D. Meldon, Nimesh Naik , [6] The primary objective of this study is to analyze the patients X-ray images using OpenCV and Deep learning and decide whether the patient has pneumonia or not.We created a deep learning model to aid and address this inconvenient situation for radiologists to achieve the patient's results which can be analyzed and reported to the patient directly. They have used Keras libraries and OpenCV for achieving a high test data accuracy rate.

3 Methodology

3.1 Abbreviations and Acronyms

CNN Convolutional Neural Network

ML Machine Learning

3.2 Obtaining the required data set

The data set used in this work contains 5,863 chest x-ray images(from Kaggle). This dataset is further divided into test, train and validation images. These images in the dataset are further divided into two categories, they are namely normal and pneumonia infected images.
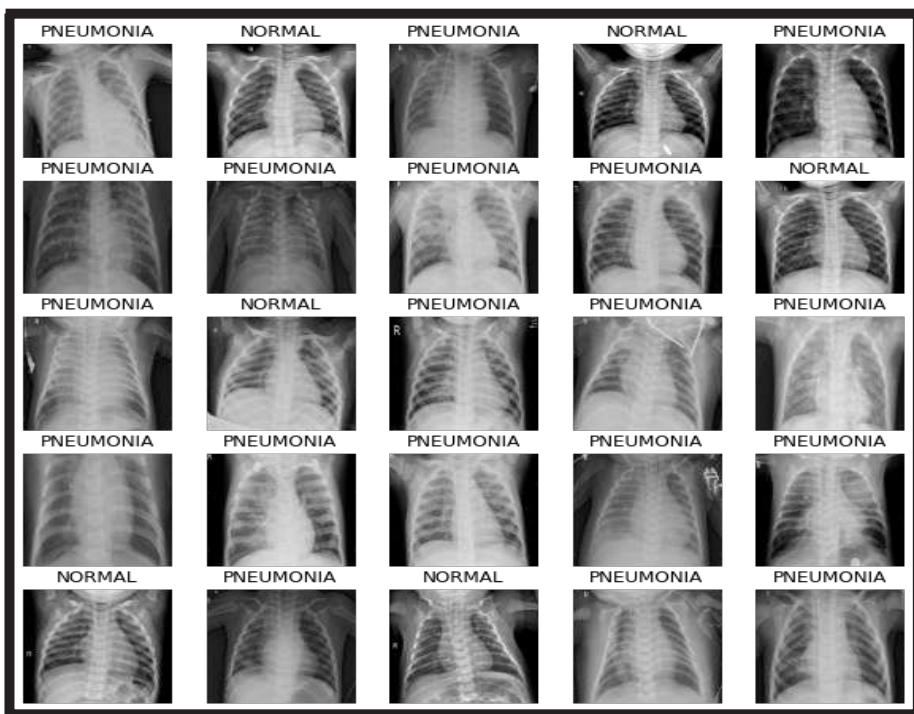
Fig. 3.1. The image contains the dataset containing images with a label (pneumonia or normal).

3.3   Working

In order to detect pneumonia on chest radiographs automatically, CNN (ConvNet) was trained from scratch. Additionally, for classifying pneumonia cases from CXR images, CNN is used for extracting image features from the images using convolution ReLU and max pooling.

Convolutional layer Convolutional layers are fundamental components of CNNs, utilizing convolution rather than matrix multiplication. These layers consist of filters, also known as convolutional kernels, which extract specific features from input images. Rectified Linear Unit (ReLU) is commonly used as an activation layer in deep learning.

Pooling layer Pooling or downsampling layers are optionally applied after the convolutional layer in CNNs to reduce the spatial size of the input data and decrease the number of parameters in the network. Max pooling is a widely used pooling technique

Fully connected layer Fully connected layers establish connections between every neuron in the previous layer and every neuron in the subsequent layer. The flattened output from the final pooling or convolutional layer serves as the input to the fully connected layer. Softmax and Support Vector Machines (SVM) are two common classifiers used in CNNs.

The Preprocessing : Model takes chest X- ray images as input and predicts whether that person has tuberculosis or not. Firstly, required libraries are imported. Later, the data set is loaded. Then, pre-processing is done. Pre-processing includes removing null values or replacing null values. Image Preprocessing is a technique in which various operations are performed on images at the lowest level of abstraction. Preprocessing removes noise and improves all the features of the image   that are relevant for further processing and analysis. In this stage the Images are resized to a preferred size that are accepted by the model.

Training the model: Initially the image data that is given as input will be divided into train, test and validation data . Training data is used to train the CNN algorithm in the model and to predict the output. Testing data is used to check if the functions produce the expected results for given inputs and also for negative testing. Validation checks to see how well the model responds to the new data and makes predictions on that data.

Model creation : Each optimizer accepts at first the parameters of the model accessible via a self-taught model thought parameters. Fine tuning the model is done on the model.
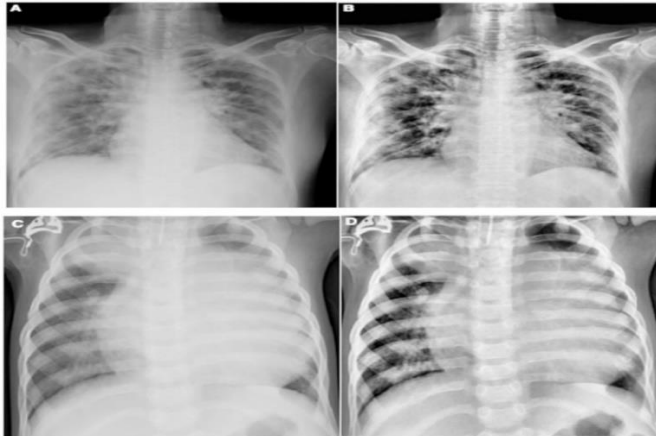

Fig. 3.2 Fine Tuning the model

Model : CNN Model Convolution neural network (CNN) assigns relative weights to different objects present in the image, and distinguishes between them. The ability of CNNs to construct an internal representation of a two-dimensional image is one of their advantages. This enables the model to learn location and scale in a variety of data forms, which is critical when working with photos. Among the most popular image analysis tasks for which CNN is used are picture identification, object detection, and segmentation.
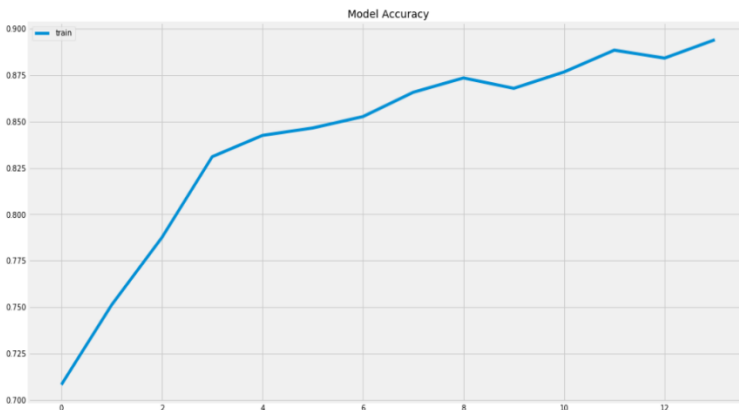
3.4   Figures and Tables

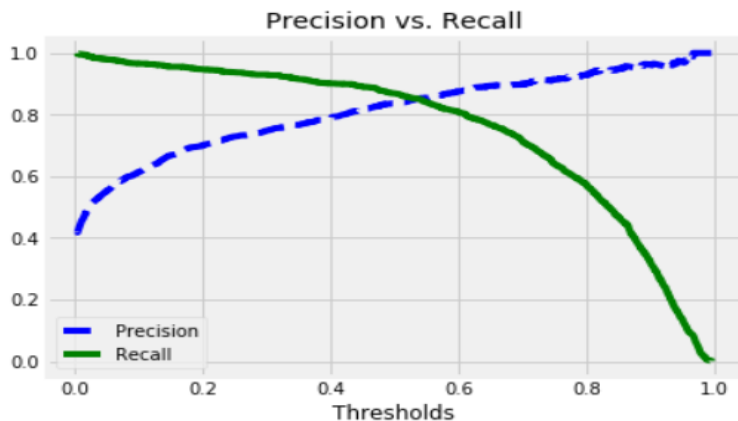**Fig. 3.3.** depicts the model accuracy graph.

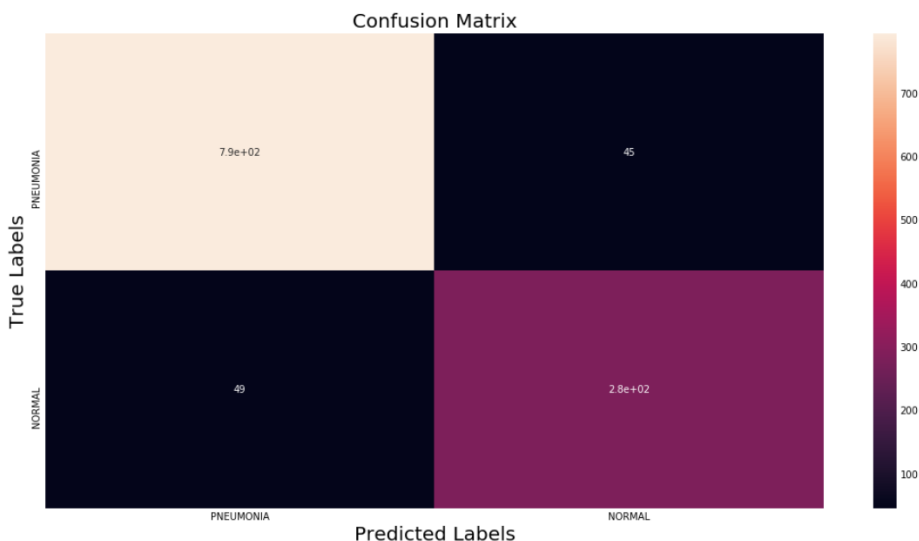**Fig. 3.4**. depicts the Precision vs Recall Curves .

Fig. 3.5. depicts the Confusion Matrix.

4   Result Analysis

Taking X-ray images as input and analyze the image using CNN ,gives output images with pneumonia or normal caption below them. Caption pneumonia indicates the person is having pneumonia and normal indicates the person is not suffering from pneumonia. The model provides the results with an accuracy of 91%.

5   Conclusion

It helps in Detecting Pneumonia using Deep Learning mechanisms like CNN Algorithm. It also helps in simplifying and understanding the diagnosis and improving disease

management. As reading and analyzing X-ray images is difficult and time taking, this helps in automatic pneumonia detection. By this a patient can know whether he/she is suffering pneumonia if so can take precautions and get treatment for cure.

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