Pneumonia Detection using convolutional Neural Network (CNN)

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Abstract

Pneumonia is the biggest cause of death in children under the age of five. According to a UNICEF study, it killed nearly 880,000 children under the age of five in 2016, accounting for roughly 16 percent of all fatalities among children under the age of five. The majority of the children that were affected were under the age of two. Early identification of pneumonia in children can help to speed up the recovery process**.** This paper proposed convolutional neural network models that accurately detect lungs pneumonia from chest X-rays, which can be utilized in the real world by medical practitioners to treat pneumonia. I have used Chest X-Ray Images (Pneumonia) dataset available on Kaggle and used Deep neural networks to train the model, I have used Resnet50 from tensor flow version 2.0 library that helps us to detect pneumonia from a chest x-Ray images and this transfer learning model archives an accuracy of 75% and recall of 87.5%.

Introduction:

Indoor air pollution is one of the leading causes of pneumonia in children. Undernutrition, a lack of safe drinking water, sanitation, and basic health services are other significant issues. Pneumonia is a bacterial, fungal, or viral infection that affects the lungs. being the world's leading cause of death among young children [1]. The pneumonia complicating recent coronavirus disease 2019 (COVID-19) is a life-threatening condition claiming thousands of lives in 2020 [2, 3].

This paper proposed convolutional neural network models that accurately detect lungs pneumonia from chest X-rays, which can be utilized in the real world by medical practitioners to treat pneumonia [4]. These models have been taught to classify chest X-ray pictures into normal and pneumonia in a matter of seconds, allowing for early pneumonia detection.

There are transfer learning models based on convolutional neural networks like AlexNet, ResNet50, InceptionV3, VGG16

and VGG19 that are some of the most successful ImageNet dataset models with pre-trained weights. I have used Resnet50 for this project.

Pneumonia

Pneumonia is a form of acute respiratory infection that affects the lungs. The lungs are made up of small sacs called alveoli, which fill with air when a healthy person breathes. When an individual has pneumonia, the alveoli are filled with pus and fluid, which makes breathing painful and limits oxygen intake.[5] Children can be protected from pneumonia, it can be prevented with simple interventions, and treated with low-cost, low-tech medication and care.[5]

Causes of pneumonia:

Pneumonia is caused by a number of infectious agents, including viruses, bacteria and fungi. The most common are:

- Streptococcus pneumoniae – the most common cause of bacterial pneumonia in children;
- Haemophilus influenzae type b (Hib) – the second most common cause of bacterial pneumonia;
- respiratory syncytial virus is the most common viral cause of pneumonia;
- in infants infected with HIV, Pneumocystis jiroveci is one of the most common causes of pneumonia, responsible for at least one quarter of all pneumonia deaths in HIV-infected infants [5].

Methodology

For the analysis of chest x-ray images, all chest radiographs were initially screened for quality control by removing all low quality or unreadable scans. The diagnoses for the images were then graded by two expert physicians before being cleared for training the AI system. In order to account for any grading errors, the evaluation set was also checked by a third expert.[6]

I have used Chest X-Ray Images (Pneumonia) dataset available on Kaggle. There are 5,863 chest X-rays. Labeled as Normal chest X-ray and pneumatic chest X-rays. Normal chest X-ray images seems more clearer and without any white clouds (infiltrates) and pneumatic chest x-ray having little blurry boundaries and with white clouds (infiltrates). So that we can easily differentiate between normal and pneumatic chest x-rays. the chest X-rays

I have used Kaggle notebook to do this project. as dataset having large amount of data so if I perform it on local machine and it took 18 hours to train the model, so that I shifted to Kaggle notebook it provides GPU (graphical processing units), using GPU it took only 20 minutes to train the model.

Figure 1

some sample chest x-ray that are used for training

Model Architecture

Resnet50: Resnet stands for Residual Networks. ResNet has many variants that run on the same concept but have different numbers of layers and 50 shows number of layers. so we can say ResNet-50 is a convolutional neural network that is 50 layers deep.

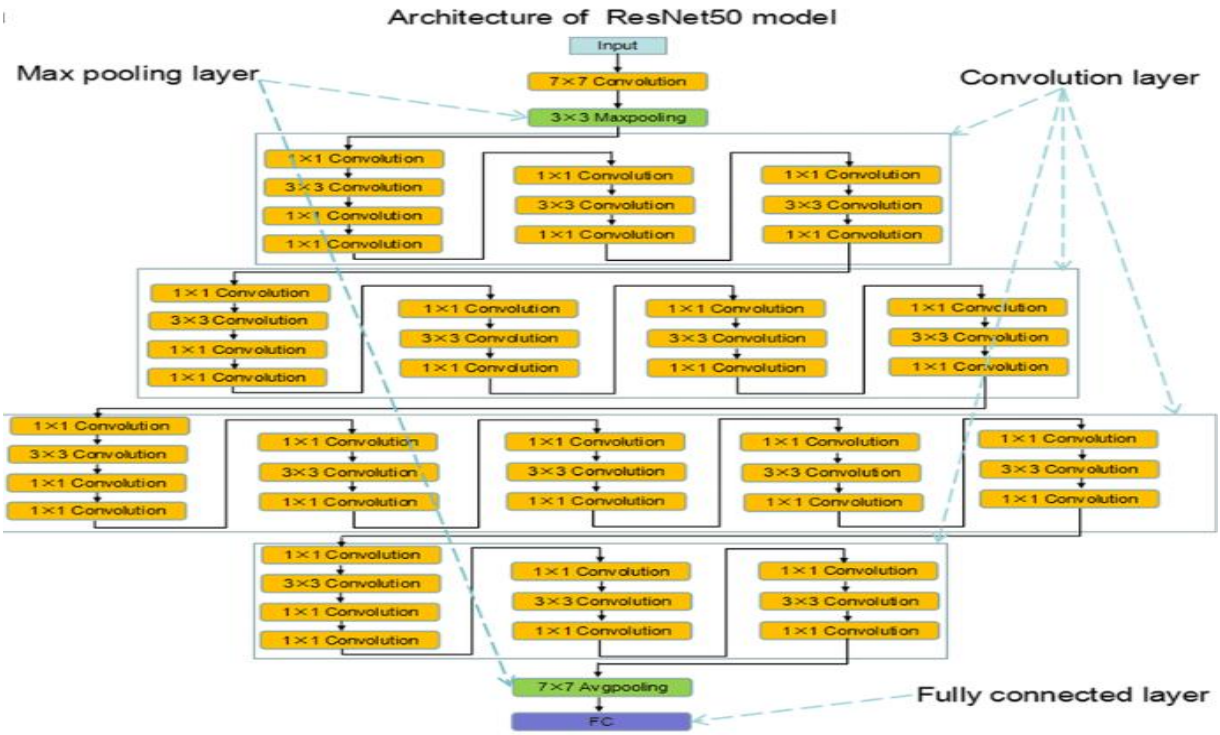


Figure 2 The architecture of ResNet50 and deep learning model flowchart. a, b Architecture of ResNet50 is shown and includes convolution layers, max pooling layers, and a fully connected layer

Data

Chest X-ray images (anterior-posterior) were selected from retrospective cohorts of pediatric patients of one to five years old from Guangzhou Women and Children's

Medical Center, Guangzhou. All chest X-ray imaging was performed as part of patients' routine clinical care.[6]

The dataset contains 3 folders (train, test, val) and contains subfolders for each image category (Pneumonia/Normal). There are 5,863 X-Ray images (JPEG) and 2 categories (Pneumonia/Normal).

Training : Images of this folder is used for training the model it consists of total 5216 images 1341 normal chest x-ray and 3875 pneumatic chest X-ray .

Before inputting the images into the network, we downscale the images to 224x224 and normalize based on the

mean and standard deviation of images in the Resnet training set. We also augment the training data with random horizontal pipping.

When the model gets trained, we do testing of our chest X-ray images for that we imported the data again.

Source code and dataset are available at

Dataset:https://www.kaggle.com/paultimothymooney/chest-xray-pneumonia

Sourcecode:https://github.com/Durgesh2050/Artificial-Intelligence-and-Neural-networks

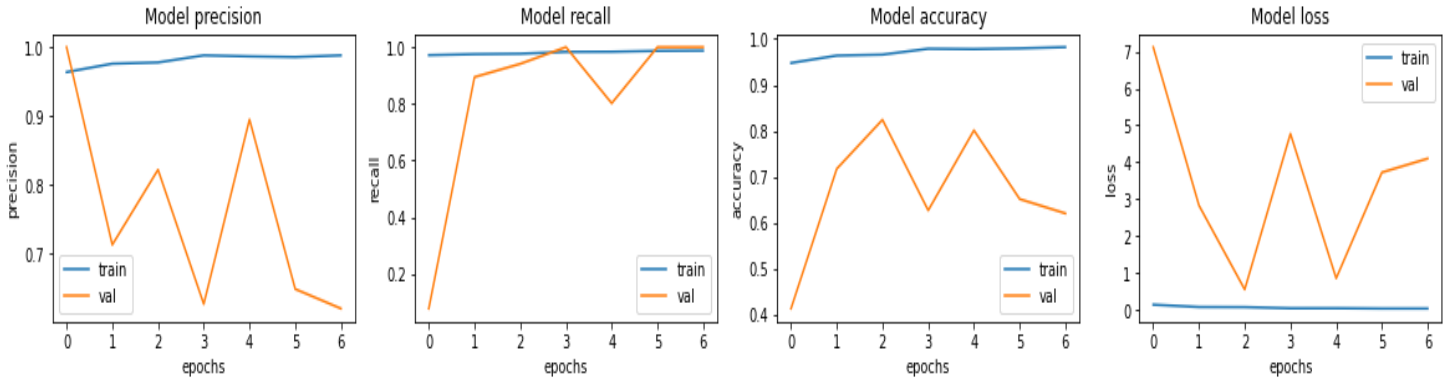
Results

In this project I took total 5863 chest X-ray images to test weather a person having pneumonia or his chest x-ray is normal. I have trained Resnet model with 5216 chest X-ray images. As it's a medical problem calculation of recall (Tp/Tp+Fn) and precision (Tp/Tp+Fp) is must. It gives quite good recall of 87.5%.

The Testing accuracy of model is `0.75`, Testing pression of model 0.699999988079071

Testing Recall of model is **0.875**

Figure 3 This graph shows the how our model performed based on some parameters Precision, recall , loss and Accuracy . Blue line shows the how training and orange line show the validation.



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