Lung Disease (Pneumonia) Detection using TensorFlow

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Abstract - *Misdiagnosis is still particularly evident in respiratory diseases. There is a real need to expand the study accurate diagnosis as many lung diseases affect children. Excessive diagnosis is a problem and necessary to deal with. Unlike other methods that rely solely on transfer learning methods or traditional techniques designed to achieve significant divisive functionality, we created a convolutional network model from scratch to extract features from a chest X-ray image and differentiate to determine whether a person has pneumonia using TensorFlow. This proposes a model of a convolutional neural network trained from the outset to isolate and detect the presence of pneumonia from a collection of X-ray image samples from the chest Images. It is difficult to find a large number of cases of pneumonia in this classification operation; therefore, we invested in the accuracy of the CNN model category and obtained significant verification accuracy. The illustration of the system has been shown on Google Colab. This system will help to detect whether a person is suffering from pneumonia or not thereby creating more awareness in healthcare.*

Key Words: **Pneumonia, Detection, X-ray images, Convolutional Neural Network, TensorFlow**

1. INTRODUCTION

The risk of pneumonia is high for many, especially in developing countries where billions suffer from energy poverty and rely on fossil fuels. The WHO estimates that more than 4 million premature deaths occur each year from household airborne diseases including pneumonia More than 150 million people develop pneumonia each year, especially children under the age of five. In such regions, the problem can be exacerbated by a lack of medical and staff resources. For example, in 57 African countries, there is an estimated 2.3 million doctors and nurses. In these areas, accurate and prompt diagnosis means everything. It can ensure timely access to treatment and saves much-needed time and money for those already suffering from poverty.

The deeper types of neural networks are structured in a common way, and tests are performed on them by human experts in a continuous way of trial and error. This process requires a lot of time, knowledge, and resources. To overcome this problem, a novel but simple model is performed to perform automatic isolation functions with a deep neural network structure. The design of the neural network was specifically designed for pneumonia image processing activities. The proposed procedure is based on a convolutional neural network algorithm, which uses a set of neurons to convince a given image and extract the relevant features from it. Demonstration of the effectiveness of the proposed method with a reduction in computer costs as the focus point was driven and compared with networks from the pneumonia phase. CNN follows a sequence model that works to build a network, like a skin, and ultimately provides a fully connected layer where all the sensors are connected to each other and the result is processed. This composite layer of the convolutional neural network works well in the absorption of a different condition and contains less contact with the binding weights. Compared to fully connected networks of equal size, CNNs have a much smaller number of parameters. Most importantly, gradient based algorithms have been used to train CNNs and tend to reduce gradient problem. Since the algorithm in the gradient is responsible for training the entire network to directly reduce the error condition, highly optimized tools can be produced by CNN.

2. LITERATURE REVIEW

Tawsifur Rahman, Muhammad E. H. Chowdhury, Amith Khandakar, Khandaker R.Islam, Khandaker F. Islam, Zaid B. Mahbub, Muhammad A. Kadir1, Saad Kashem[1]

In this paper, the purpose of this proposed program is to automatically detect bacterial and viral pneumonia using digital x-ray images. Four different pre-trained Convolutional Neural Networks have been used: AlexNet, ResNet18, DenseNet201 and SqueezeNet were used for learning to transfer. 5247 chest x-ray images containing bacteria, viruses and chest x-rays were used and by using advanced techniques, the converted images were trained for learning-based classification work. The accuracy of the classification of common and pneumonia images, images of viral and viral pneumonia, and common, bacterial and bacterial pneumonia were excellent respectively. Therefore, the proposed system can help in the early detection of pneumonia by a radiologist and can assist in rapid flight screening of pneumonia patients.

Vikash Chouhan , Sanjay Kumar Singh , Aditya Khamparia , Deepak Gupta , Prayag Tiwari , Catarina Moreira , Robertas Damaševiˇcius ,* and Victor Hugo C. de Albuquerque [2]

Nowadays, pneumonia is among the leading causes of death worldwide. Bacteria, bacteria, and fungi can all form pneumonia. However, it is difficult to diagnose pneumonia by simply looking at X-rays on the chest. The purpose of the proposed program is to simplify the process of obtaining pneumonia for both professionals and novice. The authors suggest a novel reading framework for the diagnosis of pneumonia using the concept of transmitting reading. In this way, the features from the images are extracted using a variety of neural network embedded in ImageNet, and then inserted into the predictive separator. They also developed five different models and analyzed their performance. Subsequently, a combination model was developed that incorporated extracts from all pre-made models, surpassing individual models, reaching technological performance in the diagnosis of pneumonia.

Sammy V. Militante, Brandon G. Sibbaluca [3]

In today's world, Chest X-rays are a common method used to diagnose pneumonia and require a medical professional to evaluate the outcome of the X-ray. The problematic approach to pneumonia results in loss of life due to improper diagnosis and treatment. With the advent of computer technology, the development of an automated system for diagnosing pneumonia and treating the disease is now possible especially if the patient is in a remote area and medical services are limited. This paper aims to introduce in-depth study methods to reduce this problem. The Convolutional Neural Network is designed to do the hard work of diagnosing diseases such as pneumonia to help medical professionals diagnose and treat the disease. The authors have developed several models to determine the best model for diagnosing pneumonia with the most accurate results. The statistical result shows that the trained model was able to diagnose Pneumonia using tested chest X-ray images.

Okeke Stephen , Mangal Sain , Uchenna Joseph Maduh , and Do-Un Jeong [4]

In this paper, the authors propose a convolutional neural network model trained to distinguish and detect the presence of pneumonia from a collection of chest X-ray image samples. Alternatively based on transmission learning methods or traditional techniques designed to achieve significant differentiating function, the authors created a convolutional neural network model to extract features from an X-ray image of the chest and isolate them to determine if a person has pneumonia. This automated model can help to reduce the reliability and interpreting challenges that are often faced when dealing with medical imaging. Unlike other deep-segmentation works with sufficient storage space for photographs, it is difficult to obtain a large amount of pneumatic data for this segmentation function; therefore, they sent more data augmentation algorithms to improve the validity and classification of the CNN model segment and found significant verification accuracy.

3. MATERIALS

OID stands for Open Image Dataset. It is very useful when it comes to computer vision applications. There are around 9 million images in the database that fall into various categories. Images in the OID database are processed by Google with labels, binding boxes, a split mask, localized accounts and visual relationships.

Kaggle is an online community where people can download data sets, share datasets created by them - in a nutshell, have a wide range of options for dealing with data.

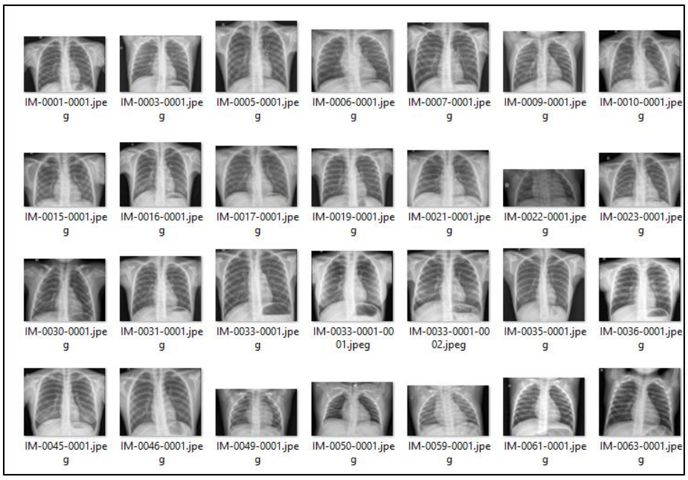

Fig-1: Sample of Data

Image datasets spanning over two different categories were required for this project- pneumonia infected images and pneumonia uninfected images. Google's OIDv4 which stands for Open Image Dataset version 4, was used for providing images for the first category. Images of type Detection already have bounding boxes drawn on them corresponding to the category selected. The required images were downloaded from Kaggle which provided a dataset which contained images which are pneumonia infected images and pneumonia uninfected images. The manual work of drawing bounding boxes on each image and preparing a custom dataset was reduced to a great extent. Each category contained approximately a little above 2000 images which included test data as well as training data.

4. PROPOSED SYSTEM

4.1 System architecture

To detect that the given input X-ray has pneumonia or not, The Input X-ray images passed through the detection model. First it will pre-process the input. The aim of pre-processing is an improvement of the image data that suppresses unwilling distortions or enhances some image features important for further processing. After preprocessing of an image it is passed through the Model. A model is the function that has been trained to recognize certain types of patterns which is trained over the set of data. So the input images is passed through the model to make a prediction. The given block diagram explains the system architecture:

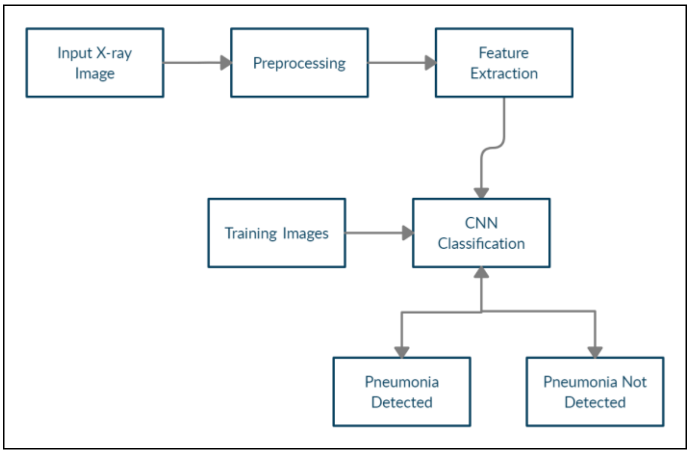

Fig-2: Block Diagram

5. METHODOLOGY

This Model is implemented using Google colab. Google colab is used because you can train large scale ML and DL models even if you don't have access to a powerful machine or a high speed internet access. Google Colab supports both GPU and TPU scenarios, making it an ideal tool for in-depth learning and data analytics enthusiasts due to the limited computer hardware component.

Also Keras is used which is a minimalist Python library for deep learning that can run on top of Theano or TensorFlow 2.0 which was developed for implementing deep learning models quickly for research and development.

CNN (Convolution neural network)

CNN is used for image classification because of its high accuracy. The CNN follows a hierarchical model which works on building a network, like a funnel, and finally gives out a fully-connected layer where all the neurons are connected to each other and the output is processed.

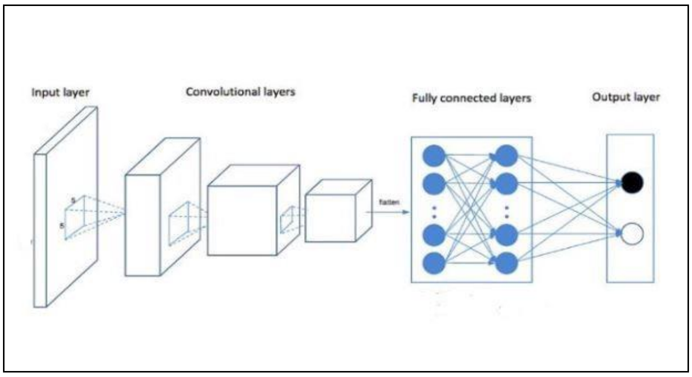

Fig-3: Fully connected layer inside CNN

1. Convolutional layer

This layer is the core building block of CNN algorithm. The objective of the convolution layer is to extract features like edges, colours, corners from the input image. As the network digs deeper it starts identifying more complex features. A neural network is a system of interconnected artificial "neurons" which exchange messages between each other. The network consists of multiple layers of feature-detecting "neurons". Each layer has many neurons which respond to different combinations of inputs, In this step we apply the rectifier function to increase non-linearity in the CNN. Every image is made of different objects that are not linear to each other.

2. Pooling layer

Layer is to reduce the size of the installed matrix even more. The dominant feature is extracted from a restricted amount of neighborhood. There are three types of pooling which are Max Pooling, Average Pooling, Sum Pooling but Max pooling is commonly used as it works better.

3. Fully connected layer

Till now there was nothing about classifying different images, only highlighted some features in an image and reduced the dimensions of the image. Here, the actual classification process occurs. Now that the given input image is converted into its suitable form for our architecture, it will flatten the input image into one column vector. Over the epochs, the model can compare between dominating and certain low-level features in images and classify them. At the end, the output layer is where we get the predicted classes.

6. RESULTS

The accuracy of this model is improved by adding more training images. It will require more GPU. The model can also be accurate by using more no of epochs.

The input images are preprocessed before deciding its class the below images shows the result of classification whether the given input images has pneumonia or not.

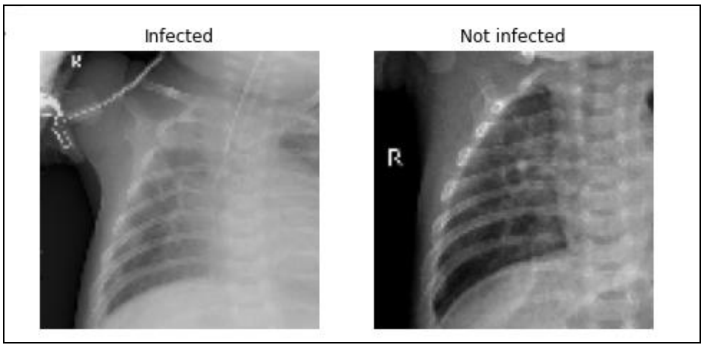

Fig-4: Pneumonia Detection

The below table shows the accuracy compared with other algorithms

Table -1: accuracy compared with other algorithms

Algorithm	Accuracy (in %)
CNN (Proposed System)	99.49
(VGG-16) [6])	94.60
VGG19[12]	92
BPNN2 [8]	80.04
SVM [11]	86.66
CNN with GIST [8]	92

7. CONCLUSIONS

This model has been developed for detection of pneumonia from the X-ray images, it is an in-depth study on a detection of pneumonia from the images. In this, the system distinguishes positive and negative pneumonia data from a collection of X-ray images. The model was originally developed, which distinguishes it from other methods that rely heavily on the transfer learning process. The model is able to achieve an accuracy of 99.46% which is quite good considering the size of data that is used. We have used only 1000 images for training and applied only 10 epochs. More number of epochs may well increase training accuracy, but this doesn't necessarily mean the model's predictions from new data will be accurate – often it actually gets worse.

In the future this work could be expanded to find and classify X-ray images of lung cancer and pneumonia. Separating X-ray images of lung cancer and pneumonia has become a major problem in recent times, and our next step should be to tackle this problem.

ACKNOWLEDGEMENT

First of all, we would like to thank Prof. Sejal Dmello, she has guided and supported us in this work. Her suggestions have really helped us to successfully complete the implementation of this program. We have benefited greatly from her vast knowledge. Her Suggestions and key entries helped us in each step. In addition, we would like to thank the entire IT Department who gave us this opportunity. Also we would like to thank Dr. Sumit shinde in approving our implementation and guiding us for future use purposes. Finally, we would like to thank all the people who have been there and supported us.

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