TEST Engineering & Management

May-June 2020
ISSN: 0193-4120 Page No. 4775-4779

An Efficient Deep Learning Approach for Pneumonia Detection

[1]Shravanthi R, [2]Chandana M, [3]Bhargava Ramamurthy, [4]Ranjitha U N
[1,2,3,4]Computer Science and Technology, Reva University, Bengaluru, India
[1]shravanthigowda88@gmail.com, [2]chandana18299@gmail.com, [3]bhargavaramamurthy@gmail.com, [4]ranjitha.un@reva.edu.in

Article Info
Volume 83
Page Number: 4775-4779
Publication Issue:
May-June 2020

Article History
Article Received:*19 November 2019*
Revised: *27 January 2020*
Accepted: *24 February 2020*
Publication: *16 May 2020*

Abstract

Pneumonia is a form of acute respiratory tract infection(ARTI) that affects the lungs which is caused by bacteria, viruses or fungi. Pneumonia is the leading disease that occurs more in children of age below 5 years. Every year almost 7,00,000 children are victimised for this disease. Hence, the accurate diagnosis of such a disease is of high importance. So, the expert radiologists role is crucial to identify the disease through chest x-ray images. But, in certain situations the doctors fail or there are no expert radiologists available in developing countries. There is a requirement of a software based support system to detect Pneumonia using Chest X-ray images to provide early diagnosis for the infected person. So, the aim of this project is to develop a software system to detect the disease Pneumonia using Chest x-ray images. This is achieved by using multiple convolutional neural network layers where the chest x-ray images are tested, trained and validated. The inception v3 model is a CNN which is 48 layers deep and is used to extract the high level features from the images. The test result obtained showed that the software is classifying the infected and non infected images. As a result, this project has reached the accuracy of 85% in detecting the disease from chest x-ray images.

Keywords: *InceptionV3 model, Convolutional Neural Network, Deep Learning, Machine Learning, Data Mining.*

1. Introduction

Pneumonia is one of the diseases that has been noted throughout human history. The bacteria that caused pneumonia was discovered in 1881 which is known as streptococcus pneumonia. It is an infection that affects lungs which produces chills, fever, coughing and difficulty in breathing in an individual. Generally, this disease is found in children of age below 5 years. Infants are affected very soon since the immune system is weak. Each year, around 1.5 million children die because of pneumonia. It is mostly seen in developing nations. Pneumonia can be cured in early stages using antibiotics. Expert radiologists can identify if an individual is normal or infected. But in certain cases radiologists may fail to identify through naked eyes or sometimes there might be scarce doctors in under developed or developing nations which can lead to death. Therefore, there is a need for a computer based support system to identify the infected and non-infected.

Hence, the project aims to achieve this by proposing a model using Deep Learning method. By using InceptionV3 which is a Convolutional Neural Network. In the world of computer vision InceptionV3 helps in the classification of objects. It was also used in life sciences, where it aids in the research of Leukemia. The dataset for the project is collected from kaggle which contains images of both infected and normal lungs. Dataset is divided into 3 categories such as train, test and validate. The training, testing and validating of datasets happens in layers of convolutional neural networks.

2. Related Work

In 2019,EnesAyan et al.[1] proposed an approach for the diagnosis of pneumonia from chest x-ray images using deep learning technique. In this paper the diagnosis of Pneumonia was approached with two well known CNN models which are Xception and VGG16. They have used fine-tuning and transfer learning methods for their

May-June 2020
ISSN: 0193-4120 Page No. 4775-4779

training stage. For the transfer learning method they have utilized DenseNet-121 layer convolutional neural network it is also known as CheXNet. The network of theirs is trained with 10.000 frontal view chest X-ray images which had 14 different diseases and achieved 90% of accuracy. Further, the process has been divided into two networks, their first network is based on the Xception model and the second one is Vgg16 based model.

Then, the two models are compared based on their performance and the results shows the Xception model takes a lead in the performance when compared to the Vgg16 model in diagnosing pneumonia. The test results of their approach in Vgg16 network and Xception network succeeded at the accuracy with 82% and 87% respectively.

In 2017, Sharma et al.[2] proposed an approach to detect Pneumonia clouds by using image processing methods. In which they proposed the method to diagnose the disease from medical images. They worked on 40 analog Chest X-ray which is partitioned to normal and pneumonia. They developed indigenous algorithms to crop and identify the boundary region of the lung from the chest x-rays. Initially, all the 40 images were resized to optimal size for computational purposes. Further, histogram equalisation was performed on the same to improve the image contrast.. Later, the abdomen area was cropped by using indigenous algorithms. Then, the region of the lung which is not cloudy was detected by using the Otsu image thresholding method and the area was computed further. Next, the non-cloudy region ratio to that of the extracted total area region of the lung, would give the cloud formation information part in the lung. Therefore, they reached the accuracy of around 76% to diagnose pneumonia.

In 2016, Barrientos et al.[3] proposed an automatic detection of pneumonia analyzing ultrasound digital images. This approach is based on the analysis of patterns present in rectangular segments from ultrasound digital images. They collected the diagnosis of pneumonia which is 15 and this was from the 23 lung ultrasound images in which 8 were healthy. Further, the similar vectors were extracted from frames and classified those same as the previous one for both positive and negative. Next, required regions were identified within images. Finally, from the regions of interest features were extracted and are given to the cnn algorithm used. This neural network algorithm uses sigmoid activation function which has three layers i.e, input, hidden and output. At last to achieve the Pneumonia detection, training and testing processes were performed. Therefore, this paper concludes that the sensitivity and specificity of the project reached 91.52% and100%.

In 2015, ChristainSzegedy et al[4] with the reference to the paper Rethinking the inception architecture for the computer vision. We find the authors focusing on the higher performing of convolution neural networks such as VGGNet and GoogleNet. It is seen that, though Inception architecture of GoogleNet process to performs well even under strict memory constraints and computational budget, when compared with VGGNet and AlexNet, which requires high computational costs, have concerns regarding its architectural complexity. This paper provides few general principles and ideas of optimization, which is helpful in scaling up convolution neural networks in efficient ways and proposes InceptionV3 model, which relatively has modest computation cost compared to simpler and more monolithic architecture. An approach for the object discovery which is able minimize the computation time was accomplished with high precision. The approach was usual to develop a confront discovery framework which is around quicker than any past approach. This paper brings together modern algorithms, representations, and bits of knowledge which are very nonexclusive and have broader application in computer vision and picture preparing. At last, this paper presents a bunch of tests on a troublesome face detection dataset which has been broadly studied.

3. Methodology

Here is the detailed working and evaluation steps of our project. Our project is based on the disease pneumonia which is detected using Chest X-rays, firstly have collected the dataset(i.e chest x-ray images) from kaggle [14].This Project as the set up of Keras which is an open source Deep Neural Network framework with the Tensorflow backend which is used to build and train the Convolutional Neural Network then we have used flask api framework for the integration of frontend and backend, flask framework is also integrated for unit testing .By using google colaboratory for running the python code, it provides faster TPU and RAM size of 12gb for the faster training process.

The dataset of our project consists of three main folders which are training, testing, and validation. These folders further contain the two subfolders Pneumonia (P) and Normal(N) Chest X-ray images. In this model a total of 5,856 X-ray images are used. The chest X-ray was managed from the patient's medical routine care. The proportion of data should be balanced for that process it is been assigned to the training and validation set and the original data will be modified. Dataset is been divided into training, testing and validation set. Here, by taking the total number of images i.e 4,898 that is been given to the training set and 3,567 images is been given to the validation set to increase the accuracy of the project.

In preprocessing of data stage, while for the data augmentation i.e in Fig-1, The process used is Image Data generator class which is used for the resizing of the chest x-ray images. In a more technical way this class is used for the horizontal translation which works on the width shifting by 0.1% and for the vertical translation which works on the height shifting by 0.1% itself which is the same as the width shift and the class mode used is categorical. In expansion, a shear extend of 0.2 percent of the picture points are in a counter clock wise heading. The zoom extends arbitrarily zoom's the pictures at the proportion of 0.2 percent, and after that at last, the pictures were flipped evenly.

May-June 2020
ISSN: 0193-4120 Page No. 4775-4779

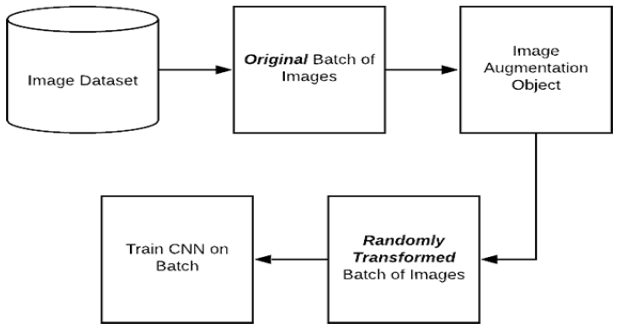

Figure 1:Data augmentation in keras.

Further, the feature extraction is also done in the data preprocessing stage. For the extraction of features is done by applying the InceptionV3 model which is a Convolutional Neural Network that is 48 layers deep. Inception v3 TPU training runs to match accuracy which is produced by GPU working of similar configuration. The model has been successfully trained on v2-8, v2-128, and v2-512 configurations. The model has attained greater than78.1%accuracy in about 170 epochs on each of these processes and it has been trained by the pretrained model of network. This pretrained model contains more than millions of images from the ImageNet database which is already trained and that network can classify images into 1000 objects or more. As a result, this Inceptionv3 model has learned an abundant feature extraction for a sample range of images. The network has input of an image size of 299-by-299.The working model of the inception v3 is derived fromFig-2.

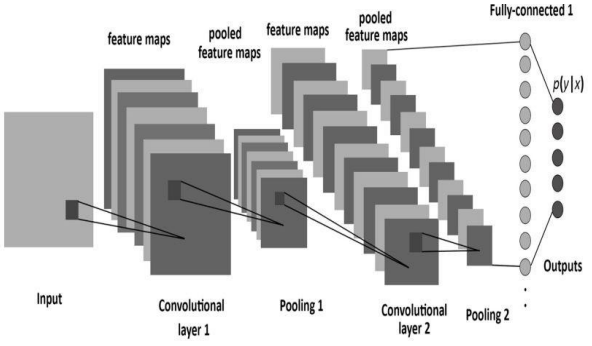

Figure 2:Architecture of InceptionV3 model.

In this process, it consists of several layers and those layers are max pooling, fully connected layer keras conv2D and activation function.

Here, the function of max pooling is used for the dimensionality reduction. The main objective of this is to scale down the given input representation. A 2D Convolution Layer as Keras Conv2D under it, this layer creates a convolution kernel that is winded with many layers of input which produces a tensor of outputs. All these conv2D and max pooling functions are applied multiple times to train the given dataset for more efficiency and accuracy. For further enhancement activation function Relu is used (i.e input max(0,x)).

Once all convolution and pooling layer functions on the input are done, then the input is processed to the fully connected layer. In this layer; it extracts all the inputs of one layer and connects it to the every activation unit of the next layer, this is used to give the final output. For the classification process we have a softmax classifier. It uses the cross-entropy loss. The removal of raw class scores into normalized positive values that sum to one is done by softmax classifier. So further the cross-entropy loss can be applied. For the compilation of the code we have used Adams optimizer algorithm to provide an optimization which can handle sparse gradients on noisy problems.

4. Results and Discussion

This project has achieved to identify whether a person has pneumonia or not. The training, testing and validating of the Chest X-ray images that are taken from kaggle is achieved successfully. By using one of the VGG16 models for testing, training and validating. The images were successfully resized, rescaled and made into batches using the keras model. Further, the model was tested by giving several images which were made into batches as input. And the result shows the images as Normal or Pneumonia. Therefore, at this step the completion of the basic training and testing part of the project is done. Then, further working of the application program interface which involved html code. Basically, the user gets an option such as select image, which has been shown in Fig-3.Userscanselect any chest x-ray image either from the dataset or google. Once after uploading the image, the user gets an option to predict. This prediction part of the interface is represented in Fig-4 and Fig-6. Once this option is clicked the result is obtained which tells that particular chest x-ray image is normal or infected by pneumonia. The images that are taken from google are also further stored in our dataset. This process helps the model to get trained even more. So, that the accuracy of the project increases. So far, the project has successfully reached the accuracy of 85% in the diagnosis of pneumonia. Hence, Fig5 and Fig-7 concludes the final outcome of our project where the model is able to identify the infected and non infected chest x-rays All the inputs given to the model are predicted correctly and leads to the success in this project.

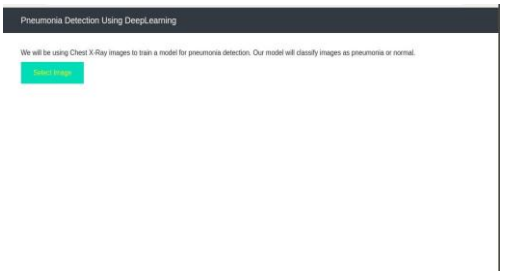

Figure 3: This is our landing page where users can upload the chest x-ray image.

May-June 2020
ISSN: 0193-4120 Page No. 4775-4779

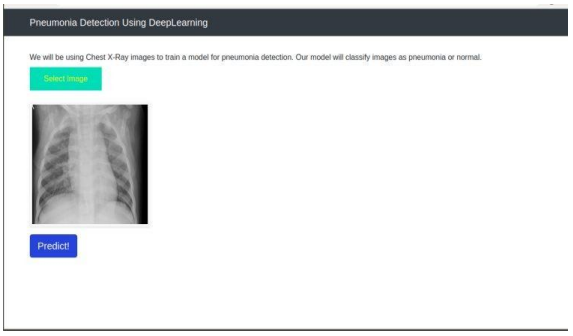

Figure 4: After uploading the image, the user gets an option to predict

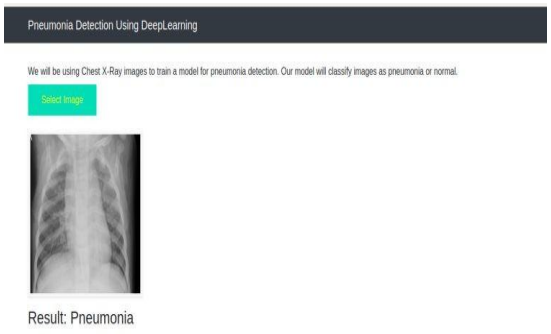

Figure 5: After analyzing the image, the result of the chest x-ray image is obtained which tells that the person has pneumonia

Figure 6: The normal chest x-ray image is uploaded

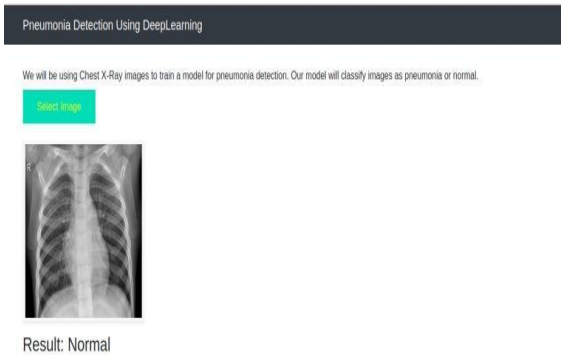

Figure 7: After analyzing, the result is obtained which says that the person is normal.

5. Conclusion and Future Scope

Early and efficient diagnosis is essential to reduce the deaths caused by pneumonia. In the areas where radiologists are in lesser numbers, our system to detect pneumonia will find itself useful. This tool can be of massive help to many of the underprivileged around the world.

Further enhancements to our work which could be performed are:

1. To find out a way to analyze pneumonia through the ultrasound video of the lungs.
2. To develop an app where not only the hospitals get access to it, even the normal people can download the app and check for the results themselves.
3. To design the algorithm to analyzergb x-ray. Presently it is designed to work for grayscale images.
4. To increase the accuracy of the project.

Acknowledgement

The final outcome and success of our project required a huge amount of guidance and motivation from our professors and friends. It's our privilege to have got all the support along the completion of our project. It's our pleasure to acknowledge the assistance provided by the School of Computer Science and Information Technology, REVA University.

References

[1] EnesAyan, Halil Murat Unver, "Diagnosis of Pneumonia from Chest X-Ray Images using Deep Learning", 2019.

[2] Abhishek Sharma, Daniel Raju, SutapaRanjan, "Detection of Pneumonia clouds in Chest X-ray using Image processing approach", 2017.

[3] Ronald Barrientos, Avid Roman-Gonzalez, Franklin Barrientos, Leonardo Solis, Malena Correa, Monica Pajuelo, Cynthia Anticona, Roberto Lavarello, Benjamin Castaneda, Richard Oberhelman, William Checkley, Robert H. Gilman, MirkoZimic, "Automatic detection of pneumonia analyzing ultrasound digital images",2016.

[4] Christian Szegedy, Vincent Vanhoucke, Sergey Ioffe, JonShlens, "Rethinking the Inception Architecture for Computer Vision",2015.

[5] Central Disease Control (2019), Pneumonia Statistics.https://www.cdc.gov/pneumococcal/about/facts.html

[6] Fact Sheet: World Pneumonia Day - Forum of International Respiratory Societies.

[7] Okeke Stephen, MangalSain, Uchenna Joseph Maduh, Do-Un Jeong, "An Efficient Deep Learning Approach to Pneumonia Classification in Healthcare",2019.

[8] InceptionV3(2020) : CNN, Available from : https://en.wikipedia.org/wiki/Inceptionv3

[9] PranavRajpurkar, Jeremy Irvin, Kaylie Zhu, Brandon Yang, Hershel Mehta, Tony Duan,

May-June 2020
ISSN: 0193-4120 Page No. 4775-4779

Daisy Ding, AartiBagul, Robyn L. Ball, Curtis Langlotz, Katie Shpanskaya, Matthew P. Lungren, Andrew Y. Ng, "CheXNet: Radiologist-Level Pneumonia Detection on Chest X-Rays with DeepLearning", 2017

[10] KalyaniKadam, Dr.SwatiAhirrao, HarbirKaur, Dr.Shraddha Phansalkar, Dr.AmbikaPawar, "Deep Learning Approach For Prediction Of Pneumonia",2019

[11] PrateekChhikara,PrabhjtSingh,PrakharGupta,Tarunpreet Bhatia, "Deep Convolutional neural network with Transfer learning for Detecting Pneumonia on Chest X-rays", 2019.

[12] Paul mooney Mar 24, 2018 https://www.kaggle.com/paultimothymooney/chest-xray-pneumona/version/2