DETECTION OF LUNG DIEASES BY ANALYSING CHEST XRAYS USING ML

Abhishek Kashyap[1], N V Adarsh[2], Anirudh Iyengar[3], Nemaly Praveen[4], Keerti Kulkarni[5]

[1]UG Student, [2]UG Student, [3]UG Student, [4]UG Student, [5]Assistant Professor,

Electronics and Communication Department, BNM Institute of Technology, Bengaluru, Karnataka, India.

Abstract: With chest x-ray being economical and one of the best method for diagnosing lung disease such as pneumonia and other abnormalities in the thoracic region, our paper takes the approach of using concepts of deep learning and Convolutional Neural Network(CNN) to predict a class of 14 diseases from chest x-ray images accurately. We train the network with help of 100,000+ images available to the public from NIH. In the end we expect this classification algorithm to assist a radiologist in diagnosis of diseases through x-ray faster and more accurate.

Keywords: **Artificial Intelligence, Machine Learning, Deep Learning, CNN, Transfer Learning, Chest Radiology.**

I. INTRODUCTION

Reading and diagnosing chest x-ray images may be a relatively simple task for radiologists but, in fact, it is a complex reasoning problem which often requires careful observation and knowledge of anatomical principles, physiology and pathology [1]. To assist doctors in diagnosing the lung diseases we have developed a machine learning model. Before we get into the explanation of our model lets understand some keywords which are crucial for the development of this method of diagnosis of Lung diseases. Chest radiography (chest X-ray) is a medical imaging technology that is low cost and easy to use. A medical X-ray image can be used to in diagnosing diseases from bones, chest, teeth, and skull and so on. Here we take particular interest in images related to that of the chest, lung, heart, airways and blood vessels. Chest diseases can be shown in CXR images in the form of cavitation, consolidations, in-filtrates, blunted cost phrenic angles, and small broadly distributed nodules [2]. By analyzing the chest X-ray image, the radiologists can diagnose many conditions and diseases such as pleurisy, effusion, pneumonia, bronchitis, infiltration, nodule, atelectasis, pericarditis, cardiomegaly, pneumothorax, fractures, and many others [3]. Artificial Intelligence is the development of computer systems that are able to perform tasks that would require human intelligence. As such, AI is a general field that encompasses machine learning and deep learning, but that also includes many more approaches that don't involve any learning. Examples of these tasks are visual perception, speech recognition, decision-making, and translation between languages. Early chess programs, for instance, only involved hard coded rules crafted by programmers, and didn't qualify as machine learning. AI can be be of two types Weak AI and Strong AI. Weak AI are Machines with weak Artificial Intelligence that are made to respond to specific situations, but cannot think for themselves and Strong AI being A machine with strong A.I. is able to think and act just like a human with the ability to learn from experiences. An application of Artificial Intelligence that gives machines the ability to learn and improve without the help of humans or new programming. In classical programming, the paradigm of symbolic AI, humans input rules (a program) and data to be processed according to these rules, and outcome answers (see figure 1.2). With machine learning, humans input data as well as the answers expected from the data and outcome the rules. These rules can then be applied to new data to produce original answers. Traditional Programming, we feed in data (input) and program (logic), run it on machine and get output. In Machine learning, we feed in data (input and Output) run it on machine during training and the machine creates its own program, which can be evaluated while testing. Deep learning, a subset of machine learning, built on a hierarchical level of artificial neural networks to carry out of machine learning. The artificial neural networks are built based on the human brain, with neuron nodes connected together similar to a web. The hierarchical function of deep learning systems enables machines to process data with a non-linear approach. A neural network allocates emphases to different neurons. A neuron is biased more than another neuron and will wield more of an effect on the next layer of neurons. The final layers patch these weighted inputs together and give an answer. These neural networks are made of layers of weighted neurons. Only they are not modelled on the workings of the brain. Every layer within a neural network utilizes a filter to pick up

shapes or characteristics. The first few layers distinguish larger features, such as diagonal lines, while the following layers pick up much finer details and combine them into complex features. Similar to an ordinary neural network, the final output layer is fully connected. The layers of neurons that are sandwiched between the first layer neuron (input layer) and the last layer neuron (output layer), are called hidden layers. Traditional neural networks only contain 2-3 hidden layers, while deep networks can have as many as 150.

II. IMPLEMENTATION

Detection of lung diseases by using x-ray is a very critical task where diseases might be overlooked easily. Hence to avoid such problem the model needs to extract a huge no. of features from the data. To do so, the best model which fits our requirement is ResNet. ResNet aka Residual Network is developed by a team from Microsoft. ResNet stood as the winner of Imagenet competition held in 2015. This model gave the ability to train a network with a huge no. of layers by solving the problem of vanishing gradient. While training a neural network, gradients are generated which are nothing but the difference between the actual output and the expected output. While this gradient propagates backward to modify the weights of different layers it gets multiplied by small number which make it even smaller. Sometimes these gradients become so small that they eventually seems negligible to the network and we call this effect as vanishing gradient. Because of this problem we could not train deep neural networks. However, ResNet architecture was introduced with skip connection which is also called as the strength of resnet. Skip connection means that in addition to traditional connection we also provide a direct link between the input and the output of the convolutional block. This single idea paved the path for developing very deep neural networks. There are many versions of the resnet. We have used ResNet 152 which as name suggests contains 152 layers.

The data which we are using to train our model is obtained from National institute of Health (NIH) of US. They have provided a collection of over 100,000 x-ray images obtained from around 30,000 patients. This data set contains pictures which are labelled from 14 different classes of disease using a natural language processing model. Its the biggest data set that is currently available to public for experimentation and image processing to develop machine learning models for diagnosis of various lung diseases. The data set has been divided into 3 parts. One for training, validation and testing each in the ratio of 80:10:10 respectively. There were many data with discrepancies such as metal ornaments and different medical tool which were present during the x-ray imagining. Such images were removed from the data set. Once, the process was done all the remaining images were re sized to 256,256 pixels. Since, the cnn requires the images of same size because of fully connected network layer presence. We have used transfer learning which is nothing but the process of using the learning from one problem to solve another problem. To train our model we did all the necessary configurations and then fed the network with the training data along with pre-trained weights from Imagenet. After the training is completed we get the trained network and its weights which undergo validation.

III. RESULTS

To do validation we fed the network with our validation data set which gave us the accuracy of 88.18% for 5 epochs. The validation results are shown in the diagram. For the final show, we fed our test data to the model. The output turns out to be around the same accuracy as that of validation. Few of the output classification are shown. A comparative chart of accuracy for validation and testing for various classes of diseases is plotted. There are multiple images which has a multi class output. Means there are many classes for which model shows a high possibility. For some it shows confidence by suggesting just one class. These weights are used to make api which will enable the users to access the model from anywhere and anytime.

Figure A- Shows the api part which takes input

We have built a front-end which is shown above where user can just import a test image of any size by using our simple interface. Then the model will predict the output and show the predicted class of diseases along with the percentage of confidence and the input image. The images below show few of the examples.

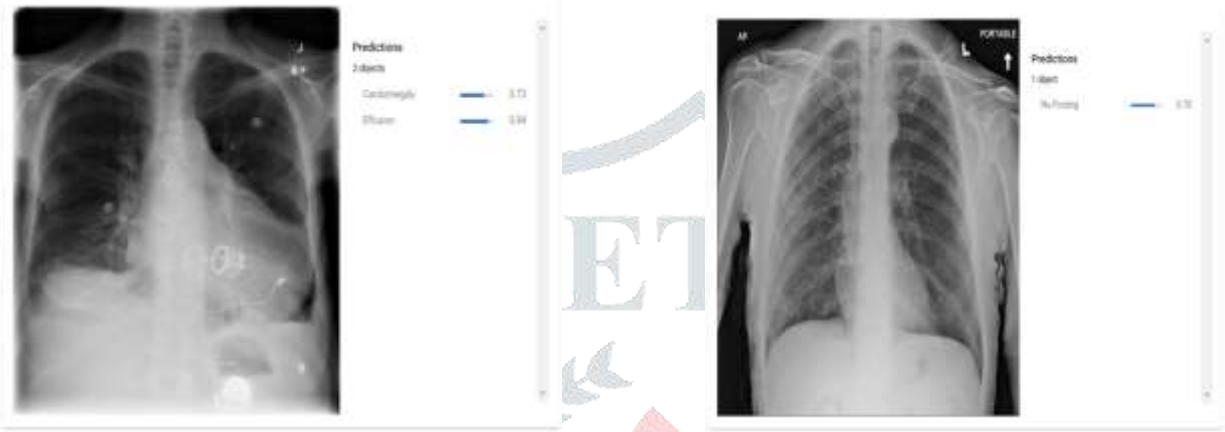

Figure B – Output of the trained model

V. CONCLUSION

Lung diseases are at peak during these days cause of air pollution and various different factors. Around half a million people dies in India due to chronic obstructive pulmonary disease (COPD). The major reason for this is the lack of knowledge about such disease among people and under diagnosis of such disease. India has a huge population and a very short number of hospitals to take care of such a large group. This makes the diagnosis of such diseases very time consuming and by the time people know about their condition, it's too late. Hence to counter this situation and to assist doctors we have developed this technique for diagnosis. By using this model, the hope is that various medical institutions will be able to perform diagnosis faster and accurate.

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