LUNG CANCER DETECTION USING DEEP LEARNING

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ABSTRACT

Monitoring health outcomes is essential to enhance quality initiatives, healthcare management, and consumer education. Lung cancer is one of the leading causes among most of the cancer deaths. Early detection of lung cancer is very important to improve the survival rate of infected patients. It also helps in reducing treatment costs and eliminates risk of surgery. Tumors can be different types such as Benign or Malignant. "Cancer" here refers to malignant tumors. In this paper, Resnet and Mobile Net deep neural networks are introduced to classify CT scan images. Resnet (Residual network) was introduced after CNN. In order to improve accuracy and performance additional layers are added to DNN (Deep Neural Network). The intuition behind this is the layers would progressively learn the features. Therefore, the lung cancer detection systems are effective in detecting the cancer at the early stage, besides the model is cost effective and time saving. Hence, the proposed model plays a vital role in diagnosis process.

Keyword : ***- Deep learning, Lung cancer , CNN , ResNet, MobileNet.***

1. INTRODUCTION

Today, according to the World Health Organization (WHO), Lung cancer is considered as the second most leading cause of death. Cancers can be of different types among which Lung cancer is one of it. Due to Lung cancer, there is abnormal cell growth in the lungs which leads to adverse effects. If there is any abnormal growth in the cells then it is most likely to be Malignant tumor. Deep Learning techniques provide us with a method of computerized analysis of CT scan of the lungs. Both Men and Women are equally affected by Lung cancer. Lung cancer is not gender specific. The tumor cells which grow in an uncontrolled manner are very harmful and need to be treated quickly. Early diagnosis and treatment can save the lives of affected people. It even reduces the cost and risk included in the surgery.

Detecting the lung cancer in early-stage aids in identification of the appropriate treatment, which increases the patients' chances of survival. The death rate of cancer can be lowered if the cancer is detected in the early stage with the help of medical practitioners. so that they can begin the treatment within the prescribed time frame. The project mainly aims at detecting the cancerous nodules by taking CT scan images as input.

Both resnet and mobile net neural networks are used to differentiate the nodule into cancerous and non-cancerous. A website is developed to upload the CT scan images and the user can choose the type of neural network to classify the nodule. Once the appropriate information is uploaded the model make use of the type of neural network mentioned and classifies the image based on it.

Moreover Section 4 specifies the data set and the research field, while Section 4-5 covers techniques and the Autoencoder model, and Section 5 and section 6 ends by describing the results of the experiment and their Performance analysis, as well as the conclusion is provided in section 6

2. LITERATURE SURVEY

In this paper [2] the authors introduced the model for both classification and prediction of lung diseases in the frontal thoracic X-ray images using the Mobile Net V2 in addition to transfer learning with metadata. In this model the usual convolution is substituted by a depth-wise convolution with a single filter, accompanied by a depth-wise severable convolution with a pointwise convolution. The introduction of RelU6 as an activation layer and the addition of Batch Normalization at each tier improved performance by lowering latency and allowing smaller networks to operate more effectively and accurately with smaller inputs. One of the important observations is that the resampling of the NIH Chest- Xray-14 gave improved performance of the MobileNet model compared to the traditional existing algorithms. The authors mainly aimed in creation of a model which is capable of being trained and modified on Smaller IOT devices with lower computing power.

The authors [4] employed Histopathology images, which are images of lung tissues used for early cancer identification in humans. The classification of lung tissues into binary patches, such as Normal and Tumor patches, is accomplished using two CNN architectures, VGG and Resnet50. This categorization is used to detect lung cancer, with a threshold of 75% suggesting that if the number of tumor patches is larger than 3/4 of the total cells, the person is diagnosed with cancer. ResNet architecture is made up of resnet blocks, which are utilized to avoid accuracy loss when creating deeper structures with additional layers. Weights that have already been learned on ImageNet are commonly used to speed up convergence. The CNN outputs are utilized to assign a likelihood of being a tumor to each patch.

In this paper [5] Fuli Zhang, proposed an automatic segmentation method with the help of modified version of ResNet that can quickly segment the gross target volume in non-small cell lung cancer cases, which is very important for radiotherapy in treatment of lung cancer. The ResNet model performs segmentation in computed tomography images of patients (on which Batch Normalization is applied) with non- small cell lung cancer. In addition, Data Augmentation techniques like flipping, horizontal rotations, zoom in ranges were applied to further improve the dataset for effective training of the model. To efficiently retrieve the feature information of the computed tomography images of the patients, two separate residual convolutional blocks were used, and the features from all layers of the ResNet were blended into a single output. To generate dense pixel outputs, this basic approach combined deep semantic features with shallow appearance features. Due to this the proposed model s hown better results than U-Net Architecture which is a benchmark for segmentation problems.

The authors in this paper [6] performed a comparative study on early detection or prediction of Lung Cancer using some of the classification algorithms like Logistic Regression, SVM, Naive Bayes and Decision tree. SVM is better for non-linearly separable datasets since it reduces the rate of misclassification. Given a set of data, the goal of SVM is to locate the least distanced point between the classes while also attempting to discover the maximum distance. To create a model in the shape of a tree data structure, decision tree employs supervised learning techniques. The tree is used to forecast the outcome given new test data. In Naive Bayes,a probabilistic value is determined to determine which class the instance (in this case cancerous cells) belongs to. The class with the highest probability value is the final class label. Using training data, the maximum logarithmic likelihood function is used to estimate logistic regression parameters. Here, logistic regression is used to distinguish between two groups (cancerous and not cancerous).

This paper [7] proposed a densely connected convolution neural network called DenseNet along with an adaptive boosting algorithm for the classification of the computed tomography (CT) images of lung as either normal or malignant. The CT images are initially pre-processed, with non-linear images being stretched and pixel values being redistributed using histogram equalization for scaling and blur reduction. The capacity of deep learning to do feature engineering on its own is its major advantage over other machine learning algorithms. The classification method utilized is ADABOOST, which evaluates the data for linked features and includes them to allow for faster learning. It takes advantage of the input's spatial coherence due to which the proposed model displayed greater accuracy.

3. PROPOSED SOLULTION

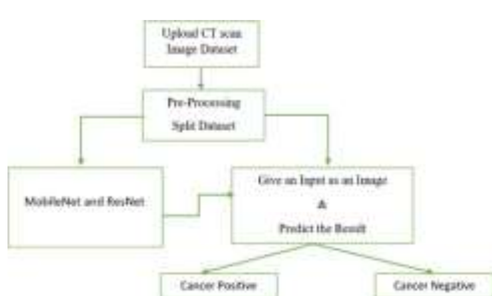

Fig -1: Model process Flow Diagram

3.1 Convolution layer

Convolution is nothing but performing operation on two functions which produces another function. In convolution layers, for a 2d array the part of array is convolved with other 2d array to get the desired results. Each element in grid is assigned with some weights. The 2d grid that is multiplied to layer can be termed as kernels. The output after convolutions depends on the weights assigned.

3.2 Activation layer

Convolutional neural network is generally used to extract and analyze features from images. Basic features are extracted at the initial level, while very high-level features are extracted at the lower level. The purpose of introducing this layer is to introduce non-linearity. This is because nonlinear functions are characterized by generalized characterization and faster training. The most commonly used activation layer is the ReLU (Rectified Linear Unit). ReLU returns 0 if the input value is 0 or less than 0, otherwise returns the output.

3.3 Convolution layer

Pooling layers allow you to extract the important or required features or transform the image. pooling layers also helps reduce network complexity by reducing spatial dimensions. Average pool and max pool are the most commonly used pool layers. The max pooling layer picks the maximum from the input region where the kernel or filter is placed, whereas the avg pooling layer takes the average of all values in the input region where the kernel or filter is placed.

3.4 Drop out layer

Dropout layers make the model to stay away from overfitting. If the model is overfit then the training accuracy Increases and validation will be low.

If we compare CNN with other algorithms, CNN requires relatively less preprocessing. In traditional algorithm, the filters are hard coded. CNN has the ability to eliminate this process and learn features/characteristics from the input data itself. CNN works best for image classification. However, CNN can be used in two ways, one using forward learning and the other using a specific integrated network. There are various pre-trained architectures that use CNN-based transmission learning, such as VGG 16, alexnet, Resnet,imagenet,mobilenet etc. All of these architectures are trained on the dataset. Feature extraction and refinement are two ways to use pre-trained architectures. In this paper, for feature extraction, mobilenet and resnet50 are used. These extracted features are then given as input to dense layers to predict output.

4. DATASET

This paper uses dataset named "Chest CT-Scan" which has been taken from Kaggle. Dataset consists of CT Scan images of lung cancer and normal. Dataset has 977 RGB images for training with respective labels and another 440 images for testing. Out of 977 training images 561 images are positive for lung cancer.

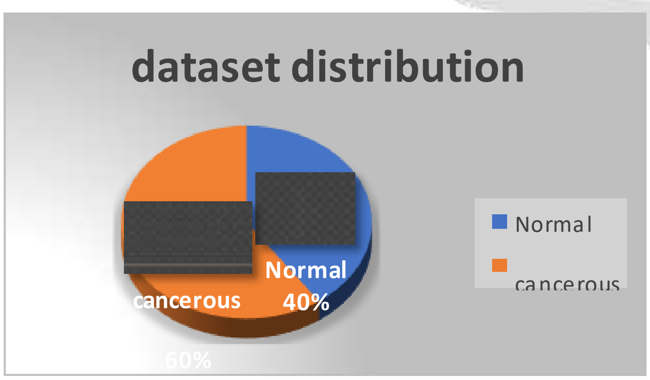

Fig -2: Pie chart of collected dataset

4. METHODOLOGY

The proposed architecture is a Convolutional Neural Network classification model. It performs binary classification on x ray images of lungs. The proposed architecture consists of pretrained architecture of resnet50 followed by dense layer. The top layer of the resnet50 is not included, the model need to classify only positive or negative, so a dense layer with 1024 neurons with activation function Relu is used. The last dense layer contains SoftMax function which gives probability of normal or pneumonia. The output from renet50 convolution layers is fed as input to the dense layers. The output of last convolution layer of resnet50 is flattened so that it can be passed to dense layers.

For pre trained architecture of mobilenet, the top layer is not included and all other layers are included. The output here is flattened and fed to the dense layers. The proposed architecture consists of 4 dense layers among which the first dense layer has 1024 neurons and the third dense layer has 512 neurons which uses ReLu as an activation function and the last layer has 2 neurons with SoftMax function which helps in predicting output results.

Mobilenet is a light weight architecture which can be used in computer applications. The proposed architecture contains user interface as website. The lung cancer image should be uploaded into the website and select the model either resnet or Mobilenet. The output will be whether the image is affected with cancer or not. The backend python code will be running in the PyCharm app.

5. MODULES

This project consists of 2 modules. They are:

1. Interactive screen
2. Deep learning model

5.1 Interactive Screen

The interactive screen is a website where input is given as CT scan Image and need to select the required model either resnet or mobilenet, then press enter. The results of image will appear whether it is negative or positive.

Fig -3: Web application interface

Fig -4: Image predictive is Negative

Fig -4: Image predictive is Positive

5.2 Model

Performance measure	Resnet50	Mobilenet
Accuracy	96	95
Precision	94	92
Recall	97	95
F1 score	95	92

Table -1: Performance of the model

model code will be running in pycharm in backend. Whenever image is passed in website by selecting required model, the output will be predicted by selected model in backend and sentto web application.

6. TRAINING

For training of renet50 model the training and test split is 60:40. For mobilenet model the training and test split is 70:30.

7. TESTING AND PREDICTING

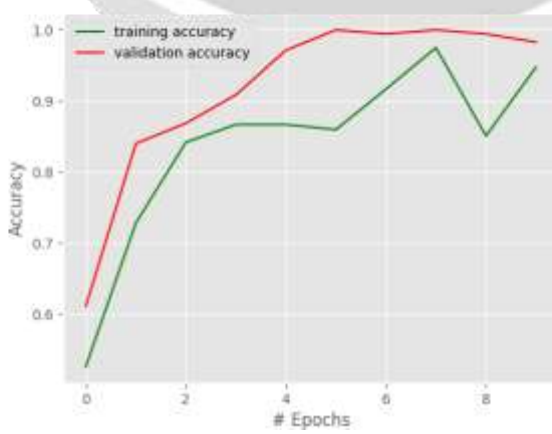

Fig -5: Resnet50 accuracy graph

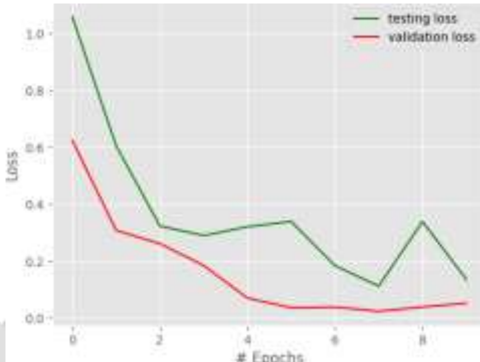

Fig -6 ResNet50 loss graph

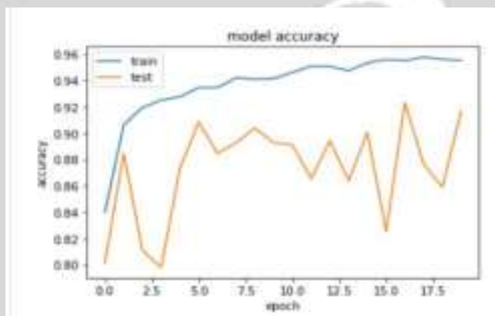

Fig -7 MobileNet accuracy graph

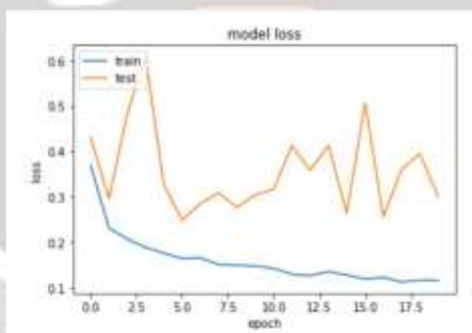

Fig -7 MobileNet loss graph

8. CONCLUSIONS

In this project, we have used Resnet and Mobile Net neural networks to classify a nodule into cancerous and non-cancerous. Along with the model we have developed a web application and used it with the help of flask framework. The Resnet model can classify the nodule in the input CT scan image with an accuracy of 96.23 and Mobile net model can classify the nodule with an accuracy of 95.01.

The project is very user friendly and it can be further extended with the hospitals. Specific hospitals which work with thecancer patients can make use of this model and can detect the type of nodule. The process is fast and accurate and we can trainthe model with real time data and can get the results accordingly.

The Resnet Model can classify the nodule in the input CT scanimage with an accuracy of 96% and mobile net model can classify the nodule with an accuracy of 95

9. ACKNOWLEDGEMENT

We would like to thank our guide Shaik Khadar sharif for his valuable guidance during project time period. A special thank you to Pycharm and Google Colab for providing free resources in saving the model results.

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