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LUNG CANCER DETECTION USING CNN

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Abstract—Lung cancer is the major cause of death. Therefore there is a need for the importance of detection of cancer in the earlier stages to reduce the mortality rate. Previously detection is based on computed tomography (CT) scans and this cost radiologists much time to detect the tumor region. So, a DLbased model is required in the detection of lung cancer on CT scan images. This method has the advantages of accessibility, cost-effectiveness, and low radiation dose. In this project, we proposed a fully automatic method (using DL) for lung cancer detection. In the first stage, lung regions are extracted from the CT image, and in that region, each slice is segmented to get tumors. The tumor regions are first segmented and then used to train CNN architecture (here we used resnet50 and vgg16).CNN takes the CT scan image's pixel data, trains the model, then extracts the features automatically for better classification.

Index Terms—Lung Cancer Detection, CT Scan,2D CNN,Resnet50, Vgg16

I. INTRODUCTION

Lung cancer has become the world's most serious cause of death [1]. It is the proliferation of expanding and developing irregular cells into a tumor. Tumors are may be benign (noncancerous) or malignant (cancerous). Benign tumors may grow large but do not spread into nearby tissues or other parts of the body. Whereas Malignant tumors can spread into nearby tissues or other parts of the body through the blood and lymph systems. That is, Cancer cells are distributed in blood from the lungs, the lymph fluid that covers the lung tissues. The lymph passes into lymph vessels that discharge through lymph nodes in the lungs and chest region. It is among the most malignant tumors that can affect human well-being [2-3]. Its death rate scores were high among all tumor deaths. There have been nearly 1.8 million cases of lung cancer annually (13 percent among all cancers), and approximately 1.6 million deaths worldwide (and it is 19.4 percent among all cancers). Cigarette smoke induces approximately 85 percent of cases of lung cancer in males and 75 percent in females [4]. Survival of lung cancer as a result of diagnosis is directly related to its stage of detection. Yet individuals have a greater success rate when it will be found in the early stages of life. Cancer cells are distributed in blood from the lungs, the lymph fluid that covers the lung tissues. Examination and treatment of lung disease have become one of humanity's biggest obstacles in recent years [5]. Early tumor diagnosis will reliably promote the survival of vast numbers of life around the world [6]. This paper introduces a method that uses a convolutional neural Network (CNN) to identify lung tumors as Cancerous or non-cancerous and shows the comparison between resnet50 or vgg16 architectures in terms of accuracy.

II. LITERATURE REVIEW

M.Gomathi and Dr.P.Thangaraj proposed the Automated CAD for Lung Nodule Detection for pulmonary nodule detection in lungs using CT Scans. In this first, they extract the pulmonary parenchyma and then detect the nodule by automatic detection method i.e., using the cad system. The result is all malignant nodules were detected and a very low false-positive detection rate was achieved.

Snehal Dabade, Shubhangi Chaudhari, Sneha Jadhav, and Arjun Nichal did a review on the cad system for lung cancer detection. They used different algorithms like SVM, watershed algorithm Contour detection, Mean Shift Algorithm, and Artificial Neural Network for the different operations on the CT chest image. From this review, they summarized that no significant improvement was observed in sensitivity, the number of false positives, and level of automation, ability to detect different types and shapes of the nodule in the studied period

Matko Sari , Mladen Russo, Maja Stella, and Marjan Sikora proposed the CNN-based Method for Lung Cancer Detection in Whole Slide Histopathology Images using resnet and vgg architectures and showed the comparison between them. They get the result that ResNet obtains higher accuracy on ImageNet dataset (75.2% vs 70.5% for Top-1 accuracy and 93% vs 91.2% for Top-5 accuracy) and VGG16 slightly outperforms ResNet50 by AUC(area under ROC curve) value.

Hua et al, Hsu, C.-H., Hidayati, S. C., Cheng, W.H., and Chen, Y.J proposed a Computer-aided classification of lung nodules on CT scan images via deep learning technique for lung cancer detection. They achieved a sensitivity of 73.40% and a specificity of 82.20% with deep belief network (DBN) architecture. They also used CNN architecture and obtained a sensitivity of 73.30% and a specificity of 78.70%.

Srinivas Arukonda and S.Sountharrajan did an investigation on lung cancer detection by using different 3D cnn techniques and observed that different 3D CNN models gave varying results. Another significant observation from this research is the variations in consumption of memory, as realized with both CPU and GPU; for the former, the model received a maximum input data of 448 X 448 X 448 pixels with memory consumption of 378.7GB RAM with a batch size of 1 and this result is in contrast to the 128X128X128 pixels with memory consumption of 11.9GB possible on GPU and they faced issues with time consumption, training complexities, and hardware memory usage, and concluded that this could make it difficult to implement the 3D model in the medical field.

III. PROPOSED METHOD

In the proposed method we are performing the classification of either the image is lung cancer or normal identification using Vgg16 and Resnet of deep learning along with the Machine learning methods. As image analysis-based approaches for medical lung classification and authentication. Hence, proper classification is important for the lung dataset that which will be possible by using our proposed method. The block diagram of the proposed method is shown in Fig.1.

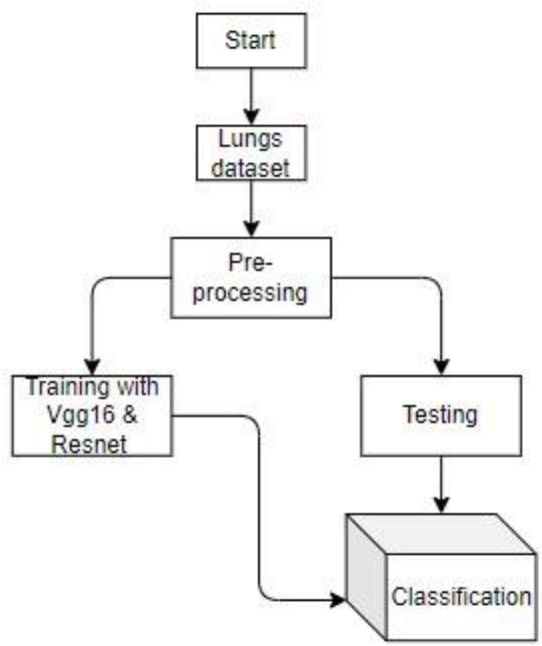

Fig. 1. Block diagram of the proposed method

A. Dataset

The dataset used here is the LUNA16 dataset. It contains a total of 5000 CT scan images out of which 2500 are cancerous and 2500 are non-cancerous. We divided the dataset into a

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training set with 4000 images and a testing set with another 1000 images. The closeup of a cancer negative nodule and cancer positive nodule from the lung dataset is shown in Fig.2 and Fig.3.

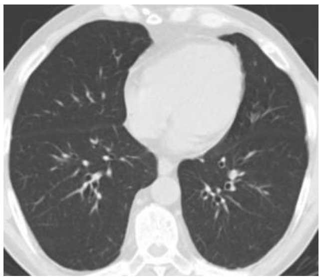

Fig. 2. Cancer Negative nodule from lung dataset

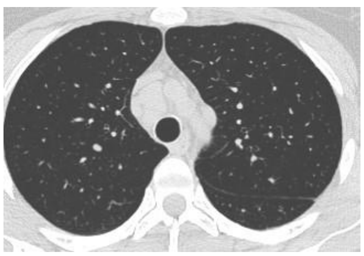

Fig. 3. Cancer Positive nodule from lung dataset

B. Convolutional Neural Network

CNN is widely used for image or object classification and detection. Convolutional Neural Networks are inspired by the architecture of the brain. Just like a neuron in the brain process and transmits data or information throughout the body whereas artificial neurons in CNN takes input then process them, and produce them as output. The basic architecture of CNN is shown in Fig.4. And from that, we can observe two parts: feature extractor and classifier. The feature extractor consists of a convolution layer, and a pooling layer whereas the classifier consists of the fully connected layer. With each layer, the CNN increases its complexity, identifying greater portions of the image.

The convolution layer is the first building block of CNN carrying the main responsibility for computation. This layer is used to extract the main features from the input CT scan images. In this layer, the filter or Kernel method is used to extract features from the input image. The primary goal of the convolutional layer is to diminish the size of the convolved feature map to decrease computational costs and this can be performed by decreasing the connections between the layers and independently operating on each of the feature maps. The Fully Connected layer consists of the weights along with the neurons and is used to connect the neurons between two different layers. These FC layers are usually placed before the output layer of a CNN Architecture.

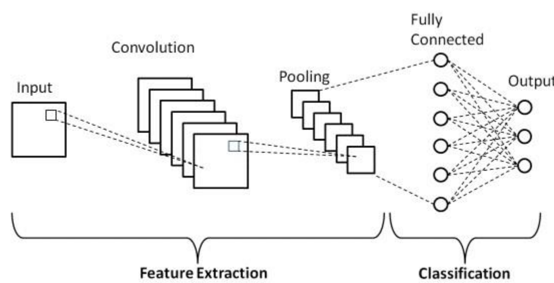

Fig. 4. CNN ARCHITECTURE

C. Architecture Used

a) Vgg16: VGG16, as its name suggests, is a 16-layer deep neural network. VGG16 is a relatively extensive network with a total of 138 million parameters. A VGG network consists of small convolution filters. VGG16 has three fully connected layers and 13 convolutional layers. VGG16 architecture does not have a large number of hyper-parameters, instead, they focus on having convolution layers of a 3x3 filter with a stride 1 and max pool layer of a 2x2 filter of stride 2. It follows the arrangement of convolution and max pool layers repeatedly throughout the architecture. In the end, Vgg16 architecture has 2 FC(fully connected layers) then followed by a softmax layer for producing the output.

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b) ResNet50: ResNet introduces a skip connection (or shortcut connection) to fit the same input from the previous layer to the successive layer without any modification of the input. The shortcut connections in ResNet solve the problem of exploding or vanishing gradient by allowing a skip or shortcut path/connection for the gradient to flow through. ResNet50 is a variant of the ResNet model which has 48 Convolutional layers along with 1 max pool layer. It has 3.8 x pow(10,9) Floating point operations. The basic ResNet architecture is shown in Fig.5.

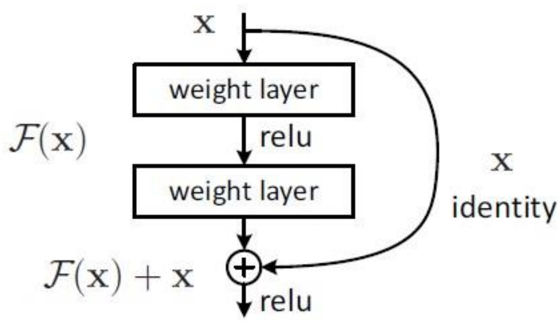

Fig. 5. ResNet Architecture

D. Tables and Results

Table I shows the accuracy obtained by using ResNet50 and Vgg16 architectures. It is observed that by using ResNet50 we obtained 0.9850 and by using Vgg16 we get 0.90175. For resnet, we have taken 20 epochs with 134 steps per epoch, and for vgg, we have taken 20 epochs with 334 steps per epoch.The plots for accuracy and loss obtained by using ResNet50 and Vgg16 architectures are shown in Fig.6 and Fig.7 respectively. This shows that using ResNet50 architecture we get higher accuracy than using Vgg16 architecture.

TABLE I
OBTAINED ACCURACY

Method	Accuracy
ResNet50	0.98
Vgg16	0.90

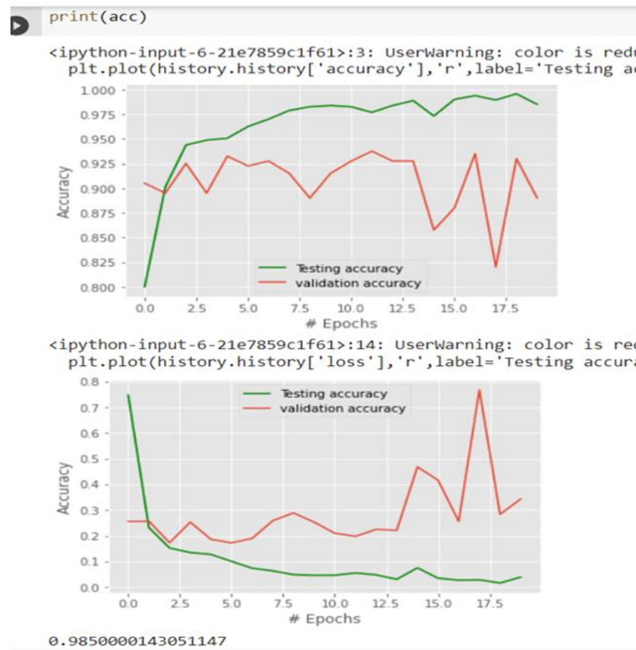

Fig. 6. Plot obtained by using ResNet50

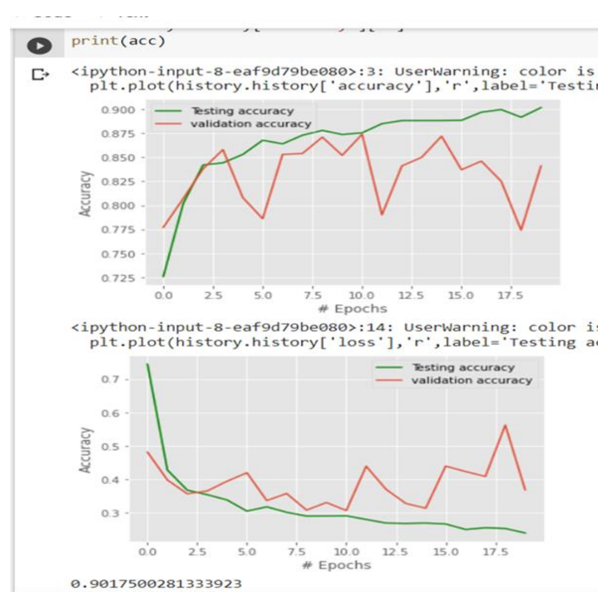

Fig. 7. Plot obtained by using Vgg16

IV. CONCLUSION

In this paper, we have successfully classified the CT scan images and Identified whether it is cancerous or not using deep learning along with machine learning methods. Here, we have considered the dataset of lung images which will be of different types (Cancerous or Non-Cancerous), and trained using Vgg16 and ResNet50 architectures along with some transfer learning methods. After the training, we tested by uploading the image and classified it. And we get higher accuracy using ResNet50 architecture than using Vgg16.

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