Lung Cancer Identification and Prediction Based on VGG Architecture

T. Ambikadevi Amma[1], Anu Rinny Sunny[2], K. P. Biji[3], Manisha Mohanan[4*]
[1]*Professor & Principal, Department of Computer Science and Engineering, Nehru College of Engineering and Research Centre, Pampady, India*
[2,3]*Assistant Professor, Department of Computer Science and Engineering, Nehru College of Engineering and Research Centre, Pampady, India*
[4]*PG Scholar, Department of Computer Science and Engineering, Nehru College of Engineering and Research Centre, Pampady, India*
*Corresponding author: manishamohanan90@gmail.com

***Abstract*: Lung Cancer – the most fatal disease in human beings is the uncontrolled growth of abnormal cells in one or both the lungs. Lung Cancer is the leading cause of cancer death worldwide. People who smoke has the highest risk of cancer. It can also occur in people who have never even smoked too. The motive of this paper is to identify the probability and predict the possibility of cancerous and non-cancerous lung cancer. A deep learning approach – which has multilayered structure is applied for accurately identifying lung cancer. Deep Learning approaches focuses on Convolutional Neural Network(CNN) in order to identify cancer cells. CNN is a class of deep neural networks most commonly it is applied in order to analyze visual images VGG i.e. Visual Geometry Group based architecture with 16 layers is used for accurate identification also a computerized tomography images is used to classify the lung nodule and provides vital information about its severity.**

***Keywords*: Lung cancer, Deep learning, VGG architecture, Image classification.**

1. Introduction

The subsets of Artificial Intelligence(AI) are machine learning and deep learning. Deep learning models are trained in such a way that they behave like humans. Deep learning is an important feature in data science where the predictive analysis is being done. In machine learning process relevant data sets is being identified and once it is done the machine learning algorithm is being selected and the model is being trained.

First it is trained with the test data and then trained according to the chosen algorithm. Once the model is trained the corresponding findings and result is done. Deep learning models automatically perform the classification tasks. They are also called as deep neural networks as they make use of neural networks. Neural networks are nothing but hidden layers in the network. Without any manual external feature they directly retrieve the data once it is feeded inside the hidden layers. Now the neural networks are more than 150 layers whereas traditionally it was upto 2-3 layers. In the hidden layers there are many networks that are interconnected together.

Traditionally machine learning is a supervised learning process which feeds the information which the user wants and then specifies the corresponding results according to the feeded information and thus the process is called as feature extraction where the features are extracted according the given information but whereas deep learning builds itself without supervision. Here first in deep learning a set of images are trained as set as test data then a predictive model is being developed and trains the test data for the predictive model. In order to achieve an accuracy for deep learning models the number of training data must be in huge amount. As the immense amount of training data set increases which results in the increased accuracy rate.

There supervised and unsupervised learning. In supervised learning, the machines are trained using data with well labeled whereas for unsupervised learning we need not to supervise the model. In supervised learning the data are collected or produce output with the previous experience whereas for unsupervised learning all specific patterns are found. In supervised learning models both the input and output is given and with the help of it the corresponding output is produced whereas for unsupervised learning only input is given and the corresponding output is produced. Regression and classification are two types of supervised learning whereas clustering and association are two types of unsupervised learning. In supervised learning for input data the algorithms used are trained with well labeled. It is a simpler method and uses training data to learn a link between input and output. The number of classes are known. The result of accuracy is highly accurate and trustworthy. For unsupervised learning, the data input is against the use of labeled for algorithms. It is computationally complex and does not use output data Here the number of classes is not known and the results of accuracy are less accurate and trustworthy method. The major difference between deep learning and machine learning is that problem solving approach. In deep learning techniques problems are solved end to end whereas for machine learning techniques problems are divided in parts and

solved separately later it is combined together at the final stage. Usually deep learning algorithms take a long time due to long parameters. If the data size is large then deep learning techniques are used whereas for small data size machine learning techniques an algorithm is been used. When a large and a complex problem is been arise the deep learning technique really shines.

Deep learning techniques have been used for many purposes such as in industries for automated driving where objects are detected automatically for stop signs and traffic lights using deep learning. It is also used in aerospace and defense in order to identify objects from satellites that locate area of interest and identify safe or unsafe zones. It is also used in industrial automation to provide safety around heavy machinery that is by automatically detection when people or objects are within an unsafe distance of machines. Deep learning technology have also been used in electronics for home assistance devices that respond to our voice and know our preferences powered by deep learning applications. The latest trending technology in deep learning been in the field of medical research. There are researchers to detect cancer cells using deep learning techniques. There are different types of cancers. Cancer is a disease in which abnormality cells divides and causes cancer. Some of the cancer are breast cancer, prostate cancer, basal cell cancer, skin cancer etc.

Lung cancer is a type of cancer that begins in the lungs. It is leading cause of cancer that occur death worldwide. People who smoke as well as the people who have never been smoked too have the possibility of occurring lung cancer. The risk of lung cancer increases with the length of time and number of cigarettes that we have smoked. If we quit smoking, even after smoking for many years, we can significantly reduce our chances of developing lung cancer.

2. Comparative Study

G. Zheng [1] proposed an inception module CNN classifiers fusion method on pulmonary nodules diagnosis by signs which focuses on different pulmonary nodules with different nodule signs. For that first we need to construct a convolutional neural network(CNN) classifier that adopts inception modules. Here, the inception based classifier offers promising performance and compares with other CADx systems.

M. Saric [2] proposed CNN based method for lung cancer detection in whole slide histopathology images focuses on early diagnosis for lung cancer. Here, the whole slide images of lung tissues samples have been used for the detection of lung cancer. Image classification is done using Convolutional Neural Network(CNN). It focuses more on error-prone and time consuming works. P. Moradi [3] proposed detecting lung cancer lesions in CT image using 3D CNN which focuses on the early diagnosis of lung cancer. Here, 3D CNN method is been used which reduces the false positive rate by detecting lung cancer lesions and improves the accuracy rate while reducing the false positive rate.

S. Kido [4] proposed detection and classification of lung abnormalities by use of CNN and regions with CNN features(R-CNN) which focuses of an image based computer aided-diagnosis (CADx) alogorithm. So, that there does not necessarily require of any image feature exactor. CADx requires lung abnormalities such as lung nodules and diffuses the lung disease. Here, also computer aided-detection(CADe) algorithm with the use of R-CNN is used for the detection of the lung abnormalities. Here, the performance is evaluated with the help of CADx and detected with the help of CADe.

P. Gang et. al. [5] proposed dimensionality reduction in deep learning for chest x-ray analysis of lung cancer which mainly focuses on some dimensionality reduction techniques such as t-distributed stochastic neighbor embedding(t-SNE), bone shadow exclusion and lung segmentation. Here such datasets have been used due to which it was found that such datasets demonstrated the highest training rate and best accuracy when it was compared with other pre-processed datasets.

T. Jin [6] proposed learning deep spatial lung features by 3D convolutional neural network for early cancer detection mainly focuses on early and accurate detection of lung cancer which is quite essential for the survival rate of the lung cancer patients. For that deep spatial lung features are explored. A 3D CNN network architecture is being constructed with the lung segments which are trained and tested.

A. M. Rossetto [7] proposed deep learning for categorization of lung cancer CT images which focuses on lung cancer that has becoming a crucial and serious health problem. If early detection is been given then that will be the best chance for the patients for recovery. Deep learning gives such an opportunity for the early diagnosis of lung cancer. Due to which the accuracy rate can be increased and also decreases the false positive rate. In this a multiple preprocessing methods are been used.

Z. Luo [8] proposed size and texture-based classification of lung tumours with 3D CNNs with focuses on exploring the current deep learning methods in the field of computer-aided diagnosis. Here a 3D CNN is used to classify lung nodules in CT scans.

J. Chen [9] proposed the effect of kernel size of CNNs for lung nodule classification focuses mainly on automatic detection of pulmonary nodules with the help of computer aided-detection system due to which reduces radiologists where they need to analyze huge number of computerized tomography (CT) images to find the nodules.

R. Golan [10] proposed lung nodule detection in CT images using deep convolutional neural networks focuses on computer aided-detection system without using any segmentations that analyzes a huge amount of image data based on different variations of lung nodules in their appearance and size.

3. METHODOLOGY

The architecture focused here is VGG architecture It is

mainly used for identification and prediction purposes.

A. *Convolutional Neural Network (CNN)*

Convolutional neural networks (CNN or ConvNet is a class of deep neural network. Convolutional neural networks are commonly used for visual imagery. A CNN consist of input, output and multiple of hidden layers. In additional to hidden layers there are convolution, pooling and fully connected layers used in the architecture of CNN. The image is taken as the input is passed through the convolution where the width and height parameter is done. Even the hyper parameters such as the input and output channels are done. The convolution layer convolves the input and is passed to the next layer. Here in convolutional neural network an input is being passed through number of hidden layers and then according max, min or avg pooling is being done then is passed through the fully connected layer where the node on one layer is passed through the node of another layer.

The convolution layer reduces the number of parameters in an image. The next is the pooling, the convolutional layer may include local and global pooling layers to reduce the dimensions of data by combining the outputs of neuron clusters at one layer in a single electron to the next layer. Global pooling includes all neurons of a convolutional layer. Max pooling uses the maximum value from each of cluster of neurons whereas average pooling uses the average value and min pooling uses the minimum value from each of cluster of neurons of convolutional layer. The fully connected layer connects every neuron in one layer to every other neuron in the next layer.

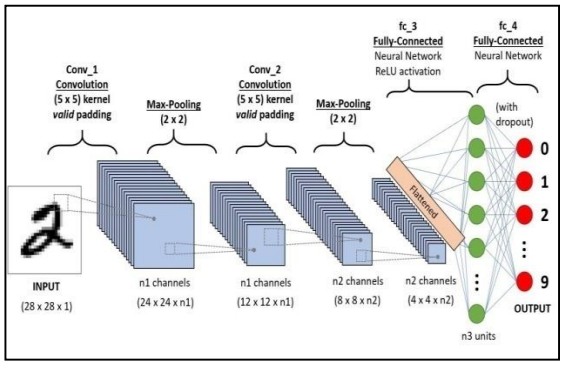

Fig. 1. CNN architecture

Fig. 1. shows the architecture of CNN which defines the number of layers used and the working of the architecture. CNN has four convolutional layers, three max pooling layers, two fully connected layers and one softmax output layer.

B. *VGG architecture*

VGG architecture is a type of CNN architecture. It is mainly used for identification and detection purposes. In this project with the help of VGG architecture identification and detection is being done for cancer cells. The layer used in VGG is 16 layers. VGG is a simpler architecture model that uses 3*3 filters with stride 1. In VGG architecture the input to convolutional layer 1 is fixed to 224*224 of an image. Then it is passed through a stack of convolutional layers where the stride is fixed to 1.

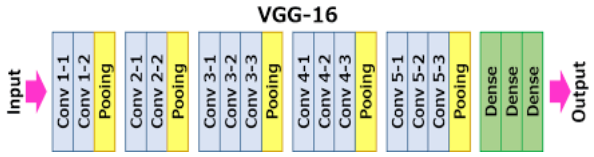

Fig. 2. VGG architecture

Fig. 2. shows the architecture of VGG which defines the number of layers used and the working of VGG architecture. There are 13 convolutional layers. That consist 5 Max Pooling layers, 3 Dense layers Which totally sums up to 21 layers. But only 16 weight layers. Convolutional 1 has number of filters as 64 while Convolutional 2 has 128 filters, Convolutional 3 has 256 filters while Convolutional 4 and Convolutional 5 has 512 filters.

C. *Proposed approach*

The working of the proposed architecture is like, an image is been taken and is converted into matrix form. Then it is passed through the hidden layers that is through convolutional layers. Here VGG architecture that is of 16 layers is used. So the image will pass and process through all 16 layers. Each layers performs some functions that is it consist of convolutional function where all the features of an image is extracted and here the matrix will perform multiplicative addition in order to reduce the size of an image. When the multiplicative addition is performed on the matrix, it compares each values in a matrix more than one except the edge values and because of that data can be lost. So for that purpose padding is being done that is adding 0 to all the edge side of a matrix which makes no change in a value. Once padding is done then pooling that is after all the values in a matrix is being done then the highest value is taken which will have the highest information which is max pooling.

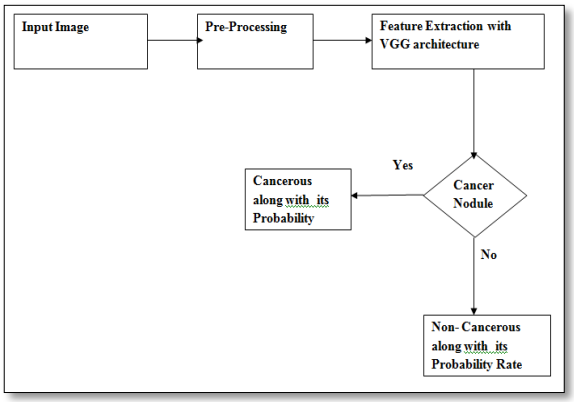

Fig. 3. Proposed architecture

Similarly, there is minimum and average pooling. Next there is a function called stride that is for comparing each matrix without skipping a single column in between a stride is been

used and it is set to 1. If we want to skip a single column while comparing each matrix then stride should be set to 2. The result is being feeded into fully connected layer that drives the final classification decision that is every node in the first layer is connected to every node in the second layer. Softmax layer maps the normalized output to the final one and will get a single vector and will similarly all other images are done. Similarly, this method is followed throughout other images respectively.

Fig. 3. shows the proposed architecture where an image is taken, pre-processed and extracted feature is passed on to the cancer nodule to identify the probability and predict the possibility of cancerous and non-cancerous in lung cancer.

4. Result and Discussion

The motive of this paper is to identify the probability and predict the possibility of cancerous and non-cancerous lung cancer and find the accurate accuracy of occurring cancerous through computerized tomography (CT) images.

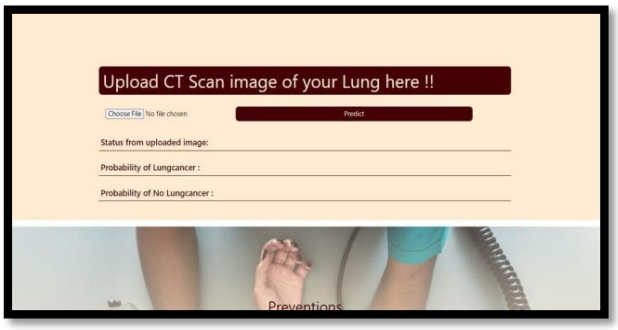

Fig. 4. Homepage

Fig. 4. shows the homepage which includes the status of lung cancer, probability rate of lung cancer and also the probability rate of no lung cancer. The computerized tomography (CT) images of lungs are uploaded.

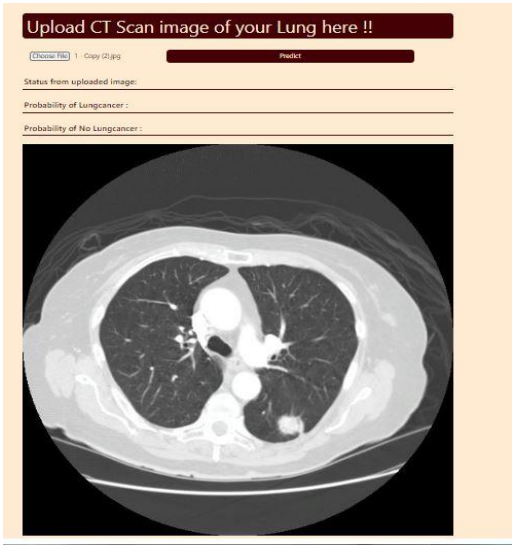

Fig. 5. Input image

In fig. 5. the input image of CT image is being uploaded.

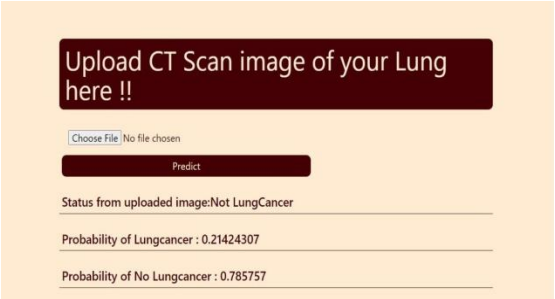

Fig. 6. Output image

In fig. 6. the output image is being displayed where the status of the uploaded image was identified and displayed as not lung cancer. It also calculated the probability rate of lung cancer which was approx. 21% and probability rate of not occurring lung cancer was approx. 78%.

Fig. 7. Input image

In fig. 7. the input image of CT image is being uploaded.

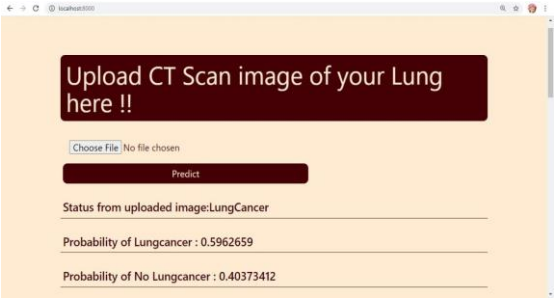

Fig. 8. Output image

In fig. 8. the output image is being displayed where the status of the uploaded image was identified and displayed as lung cancer. It also calculated the probability rate of lung cancer which was approx. 59% and probability rate of not occurring lung cancer was approx. 40%.

5. Conclusion

In this paper, both the identification and prediction of lung cancer is done in early. The architecture used is VGG which consist of 16 layers. The input is passed through all the 16 layers in order to find the best accurate results and out of that the accuracy and probability rate of VGG was found better whereas for future work, VGG can also be compared with other architectures or else the convolutional layers can be increased for better results.

References

[1] G. Zheng, G. Han and N. Q. Soomro, "An inception module CNN classifiers fusion method on pulmonary nodule diagnosis by signs," in Tsinghua Science and Technology, vol. 25, no. 3, pp. 368-383, June 2020.

[2] M. Šarić, M. Russo, M. Stella and M. Sikora, "CNN-based Method for Lung Cancer Detection in Whole Slide Histopathology Images," 2019 4th International Conference on Smart and Sustainable Technologies (SpliTech), Split, Croatia, 2019, pp. 1-4.

[3] P. Moradi and M. Jamzad, "Detecting Lung Cancer Lesions in CT Images using 3D Convolutional Neural Networks," 2019 4th International Conference on Pattern Recognition and Image Analysis (IPRIA), Tehran, Iran, 2019, pp. 114-118.

[4] S. Kido, Y. Hirano and N. Hashimoto, "Detection and classification of lung abnormalities by use of convolutional neural network (CNN) and regions with CNN features (R-CNN)," 2018 International Workshop on Advanced Image Technology (IWAIT), Chiang Mai, 2018, pp. 1-4.

[5] P. Gang et al., "Dimensionality reduction in deep learning for chest X-ray analysis of lung cancer," 2018 Tenth International Conference on Advanced Computational Intelligence (ICACI), Xiamen, 2018, pp. 878-883.

[6] T. Jin, H. Cui, S. Zeng and X. Wang, "Learning Deep Spatial Lung Features by 3D Convolutional Neural Network for Early Cancer Detection," 2017 International Conference on Digital Image Computing: Techniques and Applications (DICTA), Sydney, NSW, 2017, pp. 1-6.

[7] A. M. Rossetto and W. Zhou, "Deep Learning for Categorization of Lung Cancer CT Images," 2017 IEEE/ACM International Conference on Connected Health: Applications, Systems and Engineering Technologies (CHASE), Philadelphia, PA, 2017, pp.272-273.

[8] Z. Luo, M. A. Brubaker and M. Brudno, "Size and Texture-Based Classification of Lung Tumors with 3D CNNs," 2017 IEEE Winter Conference on Applications of Computer Vision (WACV), Santa Rosa, CA, 2017, pp. 806-814.doi: 10.1109/WACV.2017.95.

[9] J. Chen and Y. Shen, "The effect of kernel size of CNNs for lung nodule classification," 2017 9th International Conference on Advanced Info com Technology (ICAIT), Chengdu, 2017, pp. 340-344.

[10] R. Golan, C. Jacob and J. Denzinger, "Lung nodule detection in CT images using deep convolutional neural networks," 2016 International Joint Conference on Neural Networks (IJCNN), Vancouver, BC, 2016, pp. 243-250.