International Journal of Scientific Research in Computer Science, Engineering and Information Technology
ISSN : 2456-3307 (www.ijsrcseit.com)
doi : https://doi.org/10.32628/IJSRCSEIT

Prediction of Automatic Lung Tumor Segmentation using X-Ray Images

Prof. Vikram Shirol, Prof. Pavankumar Naik, Abhishek Aradhyamath, Channabasu Huded, Manojkumar Arepalli, Kotragouda Kenchanagoudra
Department of Computer Science and Engineering, SKSVMACET, Laxmeshwar, Karnataka, India

Article Info
Volume 6, Issue 4
Page Number: 1-10
Publication Issue :
July-August-2020

Article History
Accepted : 01 Aug 2020
Published : 05 Aug 2020

ABSTRACT

Pulmonary cancer also known as lung carcinoma is the leading cause for cancer-related death in the world. Early stage cancer detection using x-ray technics could save hundreds of thousands of lives every year. However analysing hundreds of thousands of these scans are an enormous burden for radiologists and too often they suffer from observer fatigue which can reduce their performance. Therefore, a need to read, detect and provide an evaluation of x-rays efficiently exists. Detection of exact tumor of lung can be done by lung tumor segmentation and accurate longitudinal tracking of tumor volume changes from x-ray images. Here we are proposing a method of detecting lung cancer in a x-ray using a 2D-UNet model . We cropped 2D cancer masks on its reference image using the center of the lung cancer given in the dataset and trained a model with different machine learning techniques and hyperparameters. In summary we have a developed an approach for volumetrically segmenting lung tumors which enables accurate, automated identification of the serial measurement of tumor volumes in the lung.

Keywords : Machine Learning, Convolutional neural network, Cancer Detection.

I. INTRODUCTION

Lung cancer is the most common cause of cancer death worldwide. In patients with lung cancer treated with systemic therapy, the relative benefits of treatment are routinely determined by measurement of changes in size of tumor lesions, usually using unidimensional measurement, such as RECIST v1[1].

Early detection and treatment of lung cancer is important in order to improve the five year survival rate of cancer patients (Lin et al 1996). In a healthy person, cells in the lungs divide and reproduce at a controlled rate to repair worn-out or injured tissues and allow for normal growth. Lung cancer develops when cells inside the lungs multiply at an uncontrollable rate. These abnormal tissue masses are called tumors. Tumors are either non-cancerous (benign) or cancerous (malignant). Medical imaging has a very significant role in cancer detection and treatment. With the help of medical imaging, physicians can diagnose diseases efficiently and effectively. X-ray diagnosis is the first step for detecting nodules. The main aim of CAD system is for helping the radiologists with greater accuracy in cancer detection. An artificial Neural Network is created for the purpose of differentiating cancerous, suspected and healthy nodules. With the introduction of various image enhancement techniques, a pre-processing stage is included which improves the closeness of diagnosis. An interesting area in medical imaging as of now is detection of golf-ball tumor type cancer. This can be detected by the presence of X-ray image.

II. LITERATURE SURVEY

Author Name	Technique applied	Limitations
[i] Worawate Ausawalaithong	Deep learning	For more tasks there exists no corresponding practically-sized deep neural network that solves the task,or even there exist one ,it may not be learnable.
[ii] A. Jemal et.al	Cancer Statistics	Difficulty in cross-sectional imaging, anxiety, and treatment-related morbidity.
[iii].Hofvind et.al 2009	Statiscs of data analysis.	Statistics cannot be applied to heterogeneous data.
[iv].Christian Szegedy et.al	Going deeper with convolutions	Lack of ability to be spatially invariant to the input data

Here we are going to compare with the deep learning approach which has got a mean accuracy of 74.43%.

III. METHODOLOGY

DATASET

Building CNN models require a lot of data. For this paper datasets has been researched and identified before any real work has begun. Since there is a heavy emphasis on building models for this paper, a key part of the paper relies on a Dataset. Prior to coding, we had to ensure we had a great dataset to work with to build a model. From doing we research there is large dataset that we could work with Kaggle. This dataset was part of the Kaggle competition Data Science Bowl. The topic of the competition was about lung cancer detection. The dataset contains full X - Ray images of a patients lungs. The dimension for this is (512,512, 20) which is (Height, Width, No. of Images). For this paper the dataset has been used to segment different parts of the X - Rays as part of feature engineering and visualizations. This dataset was what the author originally wanted to work with as the data was labeled as desired and useful for the paper. However the largest challenge that hindered the author from continuing using this data is the size of the entire dataset. The entire dataset is about 10GB zipped which could not fit on the authors laptop. Pre-processing the entire dataset would also be too computationally heavy.

Figure 1 the basic procedure of the proposed vision-based detection algorithm in this paper.

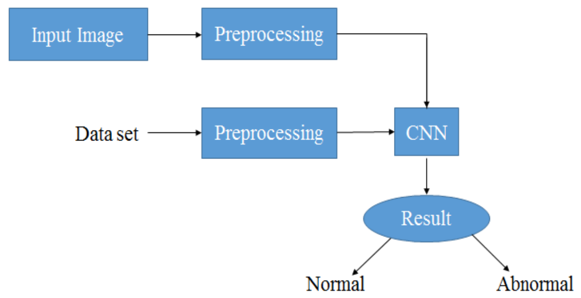


Figure 1. Block Diagram of proposed system

The input images and the datasets are provides to the pre-processing stage as well as to the CNN [3] as shown in figure. With the help of CNN, the expected outcome can be analyzed.

Training and testing of samples is carried out using the available dataset. The artificial neural network has to be initially trained with a training dataset for learning and performing classification.

Then the artificial neural network is provided with testing dataset. The results of the classification on the test cases are evaluated to check the error frequency or the error rate occurring in the classification.

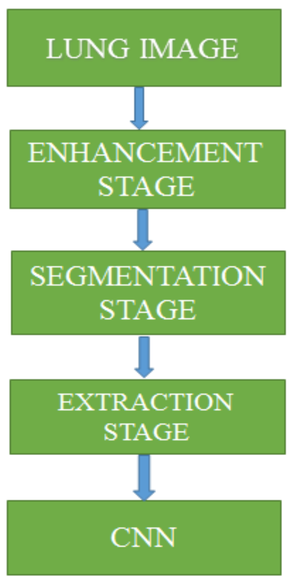


Figure 2. Stages for proposed lung cancer system.

The lung cancer images and dataset are provided to pre-processing stage. The pre-processing stage contains basic three stages like enhancement, segmentation and feature Extraction stage which will help to achieve more quality and accuracy in lung cancer. In the Enhancement stage the images of lungs will help to analyze the increase or improvement of lung cells.

In the segmentation stage we analyze the malignant tumor characterized by uncontrolled growth of the cell in tissues of the lung. In the Extraction stage the cell detection aims at the extraction of the cell region from the images. Further it will be provided to CNN stage.

In Conventional neural network we use Keras module. This Keras module determines the nodule size and its growth in most screening trials which are based on two-dimensional (2D) manual diameter measurements. The 2D measurement is subject to substantial measurement variability. 3D measurement is more sensitive compared to 2D measurement which is considered traditional. This is due to the change in volume which is more distinct than diameter as a doubling in volume is equal to a 26% increase in diameter in a spherical nodule [2]. This 3D measurement involves a 3x3 and 6x6 convolutional matrices which further helps us to rectify the edge detection and clear image of Lung which helps us to determine weather the lung is normal or abnormal.

IV.RESULTS AND DISCUSSION

Here we proposed neural networks to segment lung tumors from x-ray images by adding number of residual connection streams. Our results clearly demonstrate the development in segmentation accuracy across multiple datasets. Our approach is applicable to longitudinal tracking of tumor volumes for cancers subjected to treatment with immunotherapy, which alters both the dimensions and appearance of tumors on x-ray. The model resulted in a 75.25% accuracy using the Keras[4] on the training set. The Keras is much lower on the training set however the confusion matrix outputs a high true and false positive rate on a set that contains positive and negative samples. This indicates that the model is great at distinguishing between x-ray slices with no cancer nodules compared to the ones with cancer.

Regarding the accuracy of this paper we believe with more hyper-parameter tuning and model training, the accuracy could be increased. The accuracy actually depends on the number of datasets. The more we provide dataset the more machine gets learning task and hence trained data will be more which effects in increase of accuracy.

1	Image Ind	Finding Labels	Follow-up #	Patient ID	Patient Age	Patient Gender	View Position	OriginalImageWidth	OriginalImageHeight	OriginalImagePixelSpacing_x	OriginalImagePixelSpacing_y
2	00000013_	Emphysema|Infiltratio	5	13	060Y	M	AP	3056	2544	0.139	0.139
3	00000013_	Cardiomegaly|Emphys	26	13	057Y	M	AP	2500	2048	0.168	0.168
4	00000017_	No Finding	1	17	077Y	M	AP	2500	2048	0.168	0.168
5	00000030_	Atelectasis	1	30	079Y	M	PA	2992	2991	0.143	0.143
6	00000032_	Cardiomegaly|Edema|	1	32	055Y	F	AP	2500	2048	0.168	0.168
7	00000040_	Consolidation|Mass	3	40	068Y	M	PA	2500	2048	0.168	0.168
8	00000042_	No Finding	2	42	071Y	M	AP	3056	2544	0.139	0.139
9	00000057_	No Finding	1	57	071Y	M	AP	3056	2544	0.139	0.139
10	00000061_	Effusion	2	61	077Y	M	PA	2992	2991	0.143	0.143
11	00000061_	No Finding	19	61	077Y	M	AP	3056	2544	0.139	0.139
12	00000061_	Consolidation|Effusior	25	61	077Y	M	AP	3056	2544	0.139	0.139
13	00000079_	Mass	0	79	063Y	M	PA	2500	2048	0.168	0.168
14	00000080_	No Finding	5	80	067Y	F	PA	1884	2021	0.194311	0.194311
15	00000083_	No Finding	0	83	056Y	F	PA	2048	2500	0.171	0.171
16	00000084_	Effusion	0	84	057Y	F	PA	2048	2500	0.171	0.171
17	00000096_	Effusion	6	96	067Y	F	PA	2242	2546	0.143	0.143
18	00000099_	Effusion	3	99	056Y	F	PA	2830	2801	0.143	0.143
19	00000099_	No Finding	6	99	058Y	F	AP	2048	2500	0.168	0.168
20	00000103_	Mass|Pneumothorax	1	103	060Y	M	PA	2500	2048	0.168	0.168

Table 1 : Distribution of age and number of counts of male and female.

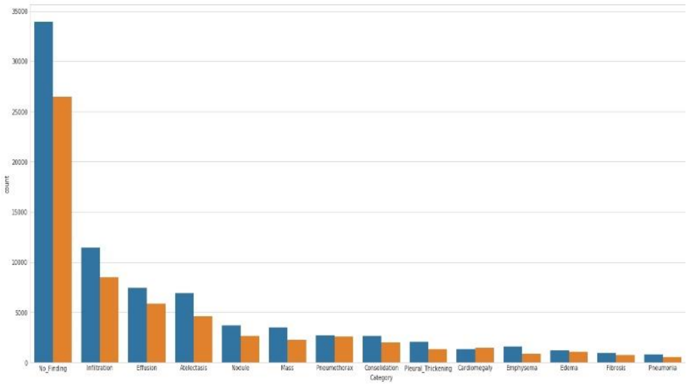


Figure 3. Number of each disease by patient gender.

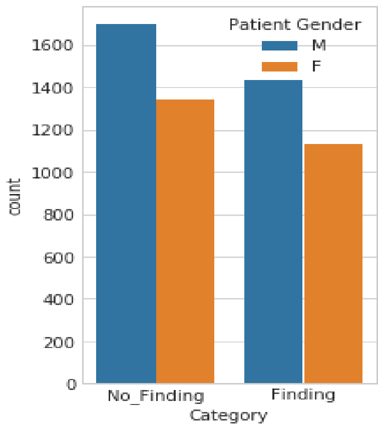


Figure 4. Distribution of Patient Gender and Finding diseases

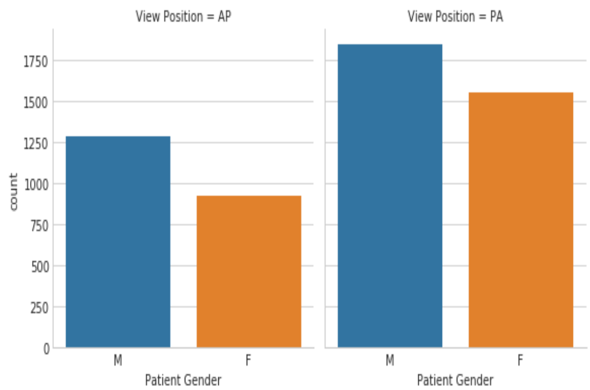


Figure 5. Distribution of Patient Gender and View Position

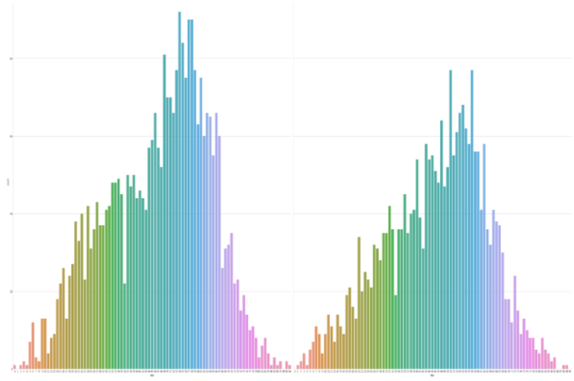


Figure 6. Age distribtion for the disease.

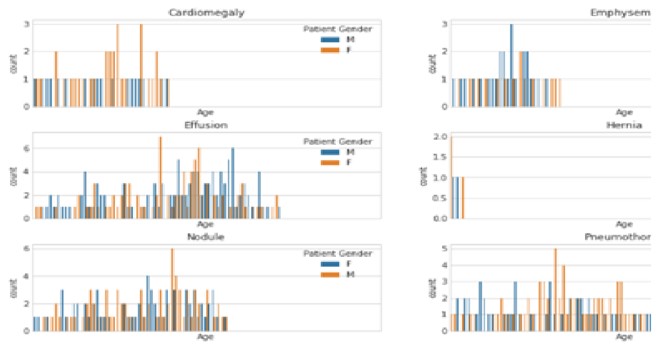
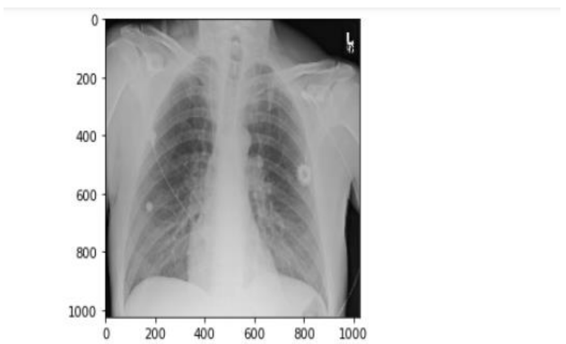


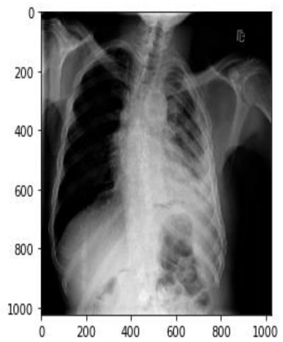
Figure 7. Distribution of Male and Female each disease.

As we can see in Fig3 the datasets has been trained and tested, further these data sets helps us to classify male and female sets and also it can differentiate according to the disease types in male and female respectively.



True: No Finding, Predict: Finding, confident: 0.692449

Figure 8. Healthy X-ray image of Lung



True: Pleural_Thickening, Predict: Finding, confident: 0.68175757

Figure 9.Diseased X-ray image of Lung

As we can see in above figures the healthy and unhealthy images of lung are been trained and tested. After all kind of procedures the CNN provides the results. As we can see in Fig4 it is healthy image which doesn't have any tumors present in it. Similarly In Fig5 we can see that the lung has tumor and the name of that particular disease is also been mentioned. The confident range helps to predict weather the report is normal or abnormal.

V. CONCLUSION

In this paper the training and testing of datasets has been carried out which further helps in development of volumetrically segmenting lung tumors which enables accurate, automated identification of the serial measurement of tumor volumes in the lung. The datasets are provided to preprocessing stage and then to Conventional neural network(CNN) which involves keras module. The 3x3 convolution matrices are used over here for rectifying the edge detection. And finally the CNN provides an output for the given image or dataset in the form of percentage along with the name of that related disease. Hence this provides as easier way for the pulmonologist to predict weather the image is normal or abnormal.

VI. REFERENCES

[1] A. Jemal, R. Siegel, E. Ward, Y. Hao, J. Xu, T. Murray, et al., "Cancer statistics, 2008," CA: a cancer journal for clinicians, vol. 58, pp. 71-96, 2008.

[2] Hofvind et al 2009; Brown et al 1996; Leivo et al 1999; Van Klaveren et al 2009.

[3] Christian Szegedy, Wei Liu, Yangqing Jia, Pierre Sermanet, Scott Reed, Dragomir Anguelov, Dumitru Erhan, Vincent Vanhoucke, and Andrew Rabinovich, "Going deeper with convolutions," in Proceedings of the IEEE conference on computer vision and pattern recognition, 2015, pp. 1–9.

[4] Worawate Ausawalaithong Kamnoetvidya Science Academy, Theerawit Wilaiprasitporn School of Information Science and Technology Vidyasirimedhi Institute of Science and Technology Rayong, Thailand.

[5] Neural Network Foundations,Explained:Activation Function,URL:-https://www.kdnuggets.com/ 2017/09/neural-network-foundations-explained-activation-function.html.
[6] Dataset-https://www.kaggle.com/4quant/soft-tissue-sarcoma/data
[7] Paper Jupyter, . URL http://www.jupyter.org

Cite this article as :

Prof. Vikram Shirol, Prof. Pavankumar Naik, Abhishek Aradhyamath, Channabasu Huded, Manojkumar Arepalli, Kotragouda Kenchanagoudra, "Prediction of Automatic Lung Tumor Segmentation using X-Ray Images ", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 6 Issue 4, pp. 370-375, July-August 2020.
Journal URL : http://ijsrcseit.com/CSEIT206471