International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 05 | May 2022 www.irjet.net p-ISSN: 2395-0072

A REVIEW PAPER ON PULMONARY NODULE DETECTION

Neethu AP[1], Reena M Roy[2]

[1]PG Student, Dept. of Electronics and Communication Engineering, LBTIW, Kerala, India
[2]Assistant Professor, Dept. of Electronics and Communication Engineering, LBTIW, Kerala, India

---

Abstract - *Lung cancer is one of the major causes of cancer- related dead word wide and the early detection of lung cancer is the best way to increase the patient's chance for survival. Accurate detection of malignant lung nodules from computed tomography (CT) scans is a difficult and time consuming task for radiologists. The size of the pulmonary nodules varies greatly and there are visual similarities with the structures such as blood vessels and shadows around the nodules, making it difficult and time consuming to accurately locate the nodules from the CT image. Hence it is a challenging task for radiologist to predict the abnormal nodules accurately. Differences in the shape and form of a lung nodule (up to 10 mm in diameter) may be lost through the manual detection process. Therefore, the computer aided diagnosis system helps radiologists to make a final decision immediately with greater accuracy and more confidence. Recently deep learning techniques used for lung nodule detection systems. The deep learning technique shows good performance and accurate result than traditional methods. This paper presents a review focusing on lung nodule detection in chest computed tomography (CT) images using different deep learning techniques and compares their results.*

***Key Words*: Computed tomography scan, Computed-aided detection, pulmonary nodule detection.**

1. INTRODUCTION

Lung Cancer is an uncontrolled growth of cell in the lung tissues, and they are malignant lung tumour and the early detection of lung cancer enhances the patient's chance for survival. Lung Cancer is one of the deadly causes of disease with the death rate is 19.4%. The function of the lungs is to allow us to breathe. They bring oxygen into our body and expel carbon dioxide. Lung cancer occurs when the cells in the lungs are transformed or replaced, and various factors can cause this transformation. The main factors that cause this change in the lung cells are when people breathe in dangerous and toxic substances. The two main types of cancerous tumors are small cell lung carcinoma (SCLC) and non-small cell lung carcinoma (NSCLC). Smoking is one of the leading causes of lung cancer. It causes about 90 percentages of lung cancer cases. Tobacco smoke contains many chemicals that can cause lung cancer.

There are several imaging methods such as Computed tomography (CT) scan, Chest X-Ray, Magnetic Resonance imaging (MRI), Sputum Cytology, Positron emission tomography (PET) scan, Sputum cytology etc. are used to detect the lung nodules early. The detection includes the grouping of tumours into two categories namely (i) non-Cancerous (benign) and (ii) Cancerous (malignant).

Unfortunately, most of the diagnoses occurs at the later stages of the disease and is largely due to a lack of early-stage symptoms and when diagnosed at the early stage of cancer, the probability of surviving increases. Differences in the shape and form of a lung nodule (up to 10 mm in diameter) may be lost through the manual detection process. The computer-assisted detection system with the help of constantly updated technology allows the radiologist to locate lung cancer tumors. It helps to improve the accuracy of detection of lung nodules, reduce the number of missing nodules and misdiagnosis.

Recently deep learning neural network techniques used for lung nodule detection systems. Machine learning algorithms are limited in processing natural images in their raw form, and take a lot of time based on expert knowledge and tuning features. The deep learning techniques overcome these limitations. The deep learning neural network technique shows good performance and accurate result than traditional methods. It also shows promising performance in speech recognition, text recognition, computer-aided diagnosis, facial recognition, and drug detection.

Nowadays deep learning algorithm is used in all areas, especially in medical image analysis, because of the multi-level abstraction and automatic extraction of features from large datasets. This paper presents a review focusing on lung nodule diagnosis in chest computed tomography (CT) images using different deep learning techniques and compares their results.

2. REVIEW ON DIFFERENT PAPERS

In 2016, stetio et al. [1] introduced a Computer-aided detection system in CT scan based on multi-view convolutional networks. The network provides nodule candidates obtained by combining three candidate detectors designed for solid, sub solid and large nodules. The proposed system shows sensitivity from 85.7% to 93.3%.

Hongyang Jiang et al. [2] suggests an effective lung nodule detection system based on multi-group patches cut from

lung images, enhanced with a Frankie filter. The four-channel Confusion Neural Network (CNN) model was designed to combine the images of the two groups and study the radiologists' ability to detect four-level nodules. This CAD scheme can achieve a sensitivity of 80.06% with 4.7 FP per scan and 94% with 15.1 FP.

In 2015 Mb Badrul Alam miah et al. [3] Proposed a method for the premature diagnosis of lung cancer. It requires several stages of image processing, such as pre-processing, thresholding, segmentation, extraction of features and neural network. To distinguish the lung CT scans as cancerous and non-cancerous, the multilayer feed forward neural network was used here. The suggested method results in 96.76 percent accuracy for the classification.

In 2018 Yutong Xie et al. [4] proposed a MultiView Knowledge-Based Collaborative (MV-KBC) deep Model for Separating Malignant-Benign Nodules. Here use 3D lung nodule characteristics which is first break into nine fixed views. Then create a knowledge based collaborative (KBC) model for each view. Nine KBC models were then used to classify the nodes. The proposed method shows an accuracy of 91.60%.

Jun Sang et al. [5] suggested a new deep learning-based model with multiple strategies for accurate diagnosis of malignant nodules. Here two deep 3D customized mixed link network (CMixNet) architectures were used to locate and classify the lung nodule. Here the lung CT image was first subjected to 3D Faster R-CNN using CMixNet and U-Net-like encoder-decoder for detecting the presence of nodules. In order to classify the nodules as benign or malignant, the detected nodules were further analyzed using GBM using 3D CMXNet. The proposed system shows a sensitivity of 94% and specificity 91%.

In 2018 Pranjal Sahu et al. [6] here a multi-section CNN was suggested to classify the lung nodules and estimate the risk of malignancy. Here used a lightweight, multi-section CNN architecture based on multiple view samples. The experiential result of the proposed framework shows a classification accuracy of 93.18% and performs better than other classification methods.

Huang et al. [7] developed a Pulmonary CAD algorithm based on four-stage pure CNN for thoracic CT scans that can automatically and efficiently divide lung nodules with a reasonable amount of false positives. The proposed method shows an accuracy of 91.4%.

In 2019 A.Masood et al. [8] developed a new CAD support system for lung nodule detection based on a 3D deep convolutional neural network. Here a median intensity projection and a multi-region proposal network were used for automatic selection of the area of interest.

In 2019 Giang Son et al. [9] Suggests a deep learning method to improve the classification accuracy of pulmonary nodules in computed tomography (CT) scans. This method is used by the 15-layer 2D Deep CNN Architecture for automatic feature extraction and for classifying pulmonary candidates into nodule or non-nodule. The proposed method shows an accuracy of 97.2%.

Table 1: COMPARISON OF REVIEW PAPER

Author	Year	Algorithm	Dataset	Description	Limitation	Sensitivity/ Specificity/ Accuracy
A.Masood et al.[8]	2020	3D- deep convolutional neural network	LUNA-16 ANODE09 LIDC-IDRI	Develop a decision support system based on 3D deep CNN.	Relatively less performance for accurately detecting ,micro nodules	98.7%
Huang et al[7]	2019	CNN, Faster R-CNN and FCN	LIDC-IDRI dataset	Developed a four-stage CNN based pulmonary CAD algorithm.	Less performance, Complex design	91.4%
Jun sang et al.[5]	2019	3D CMixNet, 3D F-CNN	LIDC-IDRI	Used 3D two deep customized mixed link networks for lung nodule detection and classification.	Computational Complexity	94% 91%
Giang Son et al. [9]	2019	2D deep convolutionalneural network	LIDC-IDRI	Used 15-layer 2D Deep CNN Architecture for automatic feature extraction and classification.	It is difficult to compare other works on pulmonary nodule classification	97.3% 96.0% 97.2%
Yutong Xie et al.[4]	2018	Multi-View Knowledge	LIDC-IDRI dataset	Proposed multi view knowledge based collaborative (MV-KBC)	High computational complexity during	91.60%

		based collaborative ((MV-KBC) Deep model		deep model to separate malignant –benign nodules.	training	
Pranjal Sahu et al.[6]	2018	Multi-section CNN	LIDC-IDRI dataset	Used a lightweight, multi-section CNN architecture based on multiple view samples.	False positive reduction system is not included	89.4% 93.18% 95.61%
Hongyang et al.[2]	2017	Convolutional Neural Network	LIDC-IDRI dataset	Developed an effective lung nodule detection system.	Not mentioned in the relevant article	80.06% 4.7FP, 94% 15.1FP
Stetio et al.[1]	2016	Multi-view convolutional networks	LIDC-IDRI dataset	Developed a CAD based on multi-view convolutional Networks.	Network complexity	93.3%
Mb Badrul Alam Miah et al. [3]	2015	Multi-layer feed forward neural network	300 lung CT images form hospital and internet	Proposed a method for the premature diagnosis of lung cancer.	Malignant nodules are not classified	96.67%

3. CONCLUSIONS

This paper presents a detailed overview of different lung nodule detection in computed tomography (CT) images of the chest using different deep learning techniques. Many researchers have developed computer-aided diagnosis system for the early detection and classification of lung nodules. Recently deep learning based methods are successfully used for the automatic detection and classification of lung nodules which show accurate result and good performance.

REFERENCES

[1] Setio AA, Ciompi F, Litjens G, Gerke P, Jacobs C, Van Riel SJ, Wille MM, Naqibullah M, Sánchez CI, Van Ginneken B. Pulmonary nodule detection in CT images: false positive reduction using multi-view convolutional networks. IEEE transactions on medical imaging. 2016 Mar 1;35(5):1160-9.

[2] Jiang, Hongyang, He Ma, Wei Qian, Mengdi Gao, and Yan Li. "An automatic detection system of lung nodule based on multigroup patch-based deep learning network." IEEE journal of biomedical and health informatics 22, no. 4 (2017): 1227-1237.

[3] Miah, Md Badrul Alam, and Mohammad Abu Yousuf. "Detection of lung cancer from CT image using image processing and neural network." 2015 International conference on electrical engineering and information communication technology (ICEEICT). ieee, 2015.

[4] Y. Xie, Y. Xia, J. Zhang, Y. Song, D. Feng, M. Fulham, W. Cai, "Knowledge-based Collaborative Deep Learning for Benign-Malignant Lung Nodule Classification on Chest CT," 2019.

[5] Nasrullah N, Sang J, Alam MS, Mateen M, Cai B, Hu H. Automated lung nodule detection and classification using deep learning combined with multiple strategies. Sensors. 2019 Jan;19(17):3722.

[6] [6] Sahu, Pranjal, Dantong Yu, Mallesham Dasari, Fei Hou, and Hong Qin. "A lightweight multi-section CNN for lung nodule classification and malignancy estimation." IEEE journal of biomedical and health informatics 23, no. 3 (2018): 960-968.

[7] Huang, Xia, Wenqing Sun, Tzu-Liang Bill Tseng, Chunqiang Li, and Wei Qian. "Fast and fully-automated detection and segmentation of pulmonary nodules in thoracic CT scans using deep convolutional neural networks." Computerized Medical Imaging and Graphics 74 (2019): 25-36.

[8] A. Masood, P. Yang, B. Sheng, H. Li, P. Li, J. Qin, V. Lanfranchi, J. Kim, D. D. Feng, "Cloud-Based Automated Clinical Decision Support System for Detection and Diagnosis of Lung Cancer in Chest CT," 2020

[9] Tran, Giang Son, Thi Phuong Nghiem, Van Thi Nguyen, Chi Mai Luong, and Jean-Christophe Burie. "Improving accuracy of lung nodule classification using deep learning with focal loss." Journal of healthcare engineering 2019 (2019).