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A Review on Lung Cancer Detection using Convolution Neural Network

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***Abstract:** Cancer is the most prominent cause of death in both, men and women. If the cancer can be detected in its early stages, then it is helpful for curing the disease in time because it is easier to treat and prevent the cancer tumor from expansion. Lung cancer can be classified in two different stages: 1. Non-small cell lung cancer and 2. Small cell lung cancer. As per the review of the different research papers, small cell lung cancer can be found in those patients who have never smoked, and non-small cell lung cancer can be found in those patients who have smoked. As lung cancer has a poor prognosis, it can be regularly analyzed at advanced stages. In this review paper, number of image processing techniques are analyzed for detecting lung cancer in both the stages, benign (small cell lung cancer) and malignant (non-small cell lung cancer).*
***Keyword:** lung cancer, image processing, benign, malignant, dicom*

I. INTRODUCTION

In U.S. total number of cases register for lung cancer is 225,000, among them 150,000 deaths are result of it and overall cost was spend for Lung cancer is $12 billion in health. When the lung cancer is detected in human life then, the average surviving years in U.S is approximately 5 year after diagnosis. In all developing countries, the survival rate is even lower. Based on the stage of the lung cancer, it is classified into stage 1 and stage 2, which are starting stage of the lung cancer and in stage 3, organs of the lung are getting separated. There are number of method are available like imaging and biopsies such as CT scan. If the lung cancer will detected in earlier stage weather in stage 1 or stage 2, then the possibilities of survival of lung cancer is maximum. But the major problem is that the lung cancer detection in early stage is quit difficult. Overall ratio of detection of lung cancer is 55% and 15% for men and women. When the lung cancer reaches to final stage then the patients feel sick and suffers a lot. After detection of the cancer is done, then the number of methods are used for the treatment of the lung cancer like, radio therapeutic and chemotherapeutic [1]. Mostly the lung nodules are identified as rounded shape.The radius of the lung cancer nodules are not more than 6cm and the diameter are smaller then 3cm. There are two common causes of lung nodule 1) Granulomatous disease 2) lung cancer. The contrast between the nodule and lung in the CT scan image is higher than that of chest radiography [1].

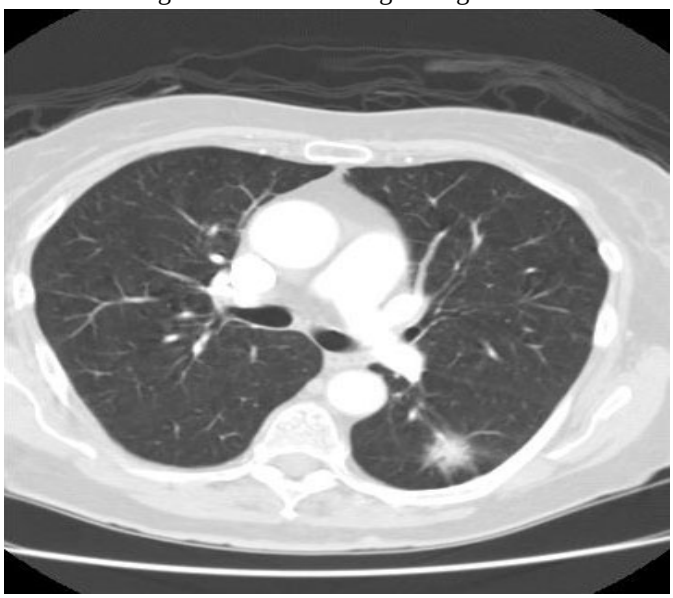

Fig 1. Image of lung cancer nodule [1]

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II. LITERATURE REVIEW

In this section, number of research papers with their publication, description of the each paper is mentioned as well as at the table of survey methods of each paper with its advantages and disadvantages is also given.

Wafaa Alakwaa, Mohammad Nassef, Amr Badr, Lung Cancer Detection and Classification with 3D Convolutional Neural Network (3D-CNN) [1]

In this paper unmark nodules are used for classification of lung-nodules using computer-aided diagnosis (CAD) system for CT scan images, for this research work author used the dataset from Kaggle Data Science Bowl 2017. For the segmentation of lung nodules the thresholding techniques was use for CT scan images.

Azian Azamimi Abdullah, Hasdiana Mohamaddiah, Development of Cellular Neural Network Algorithm for Detecting Lung Cancer Symptoms [2] In this research work X-Ray images was used for detection of lung cancer using CNN algorithm. In this work the author detected the boundary and area of lung cancer from X-Ray images. Based on this research work, they proved that the CNN is the most effective method for lung cancer diagnosis.

Prajwal Rao, Nishal Ancelette Pereira,and Raghuram Srinivasan, Development of Convolutional Neural Networks for Lung Cancer Screening in Computed Tomography (CT) Scans [3] In this paper researcher detected whether the lung cancer is malignant or benign by using the Convolution Neural Network (CNN). The reason was specified by the author in this paper why they select the CNN method for detection of lung cancer. CNN have some special properties like spatial invariance and based on CNN they can extract the number of feature like mean, variance, major axis, Minor axis and etc. In this work authors designed a new CNN for CT scan image for detecting lung Cancer.

The results of new CNN are batter compared to the traditional neural networks.

Raunak Dey, Zhongjie Lu, Yi Hong Development of Diagnostic Classification Of Lung Nodules Using 3d Neural Networks [4] in this paper authors considered the problem of diagnostic Classification between benign and malignant lung nodules in CT images, which aims to learn a direct mapping from 3D images to class labels.

To achieve this goal, four two-pathway Convolutional Neural Networks (CNN) are proposed, including a basic 3D CNN, a novel multi-output network, a 3D DenseNet, and an augmented 3D DenseNet with multi-outputs. These four networks are evaluated on the public LIDC-IDRI dataset and outperform most existing methods. In particular, the 3D multi-output DenseNet (MoDenseNet) achieves the state-of-the-art Classification accuracy on the task of end-to-end lung nodule diagnosis.

Taolin Jin, Hui Cui, Shan Zeng, Xiuying Wang, Learning deep spatial lung features by 3D convolutional neural network for early cancer detection [5] From the deep spatial lung feature they explore the lung cancer in early stage by learning method. A 3D CNN architecture is create with segmented CT lung images for training and testing sample. In this new CNN architecture the hidden layer is also extracted base on the CT slices. The new CNN model are contain 11 layer and they generate the 12,544 neurons and 16 million parameters classifying either it is malignant or benign. Classification of lung cancer author use different method of activation base on the ReLU nonlinearity and Sigmoid function. So that they can achieve the 87.5% accuracy.

Mehdi Fatan Serj ,Bahram Lavi, Gabriela Hoff and Domenec Puig Valls had been developed A Deep Convolutional Neural Network for Lung Cancer Diagnostic[6] In this paper authors proposed a new deep learning architecture for learning high-level image representation to achieve high Classification accuracy with low variance in medical image binary classification tasks. They aimed to learn discriminate compact features at beginning of deep convolutional neural network.

They evaluated our model on Kaggle Data Science Bowl 2017 (KDSB17) data set, and compared it with other related works proposed in the Kaggle competition.

Abdelwadood M. Mesleh, Lung Cancer Detection Using Multi-Layer Neural Networks with Independent Component Analysis [7] This paper presents a Computer-Aided Design (CAD) system that detects lung cancer. Lung cancer detection uses Multi-Layer (ML), Neural Networks (NNs) and Independent Component Analysis (ICA). ICA aims to speed the detection by decreasing the number of features. It investigates the performance of the ML NN classifier trained by these training algorithms with ICA feature extraction. Results reveal the robustness of the detection algorithm for real CT images. Among the 11 training algorithms, *Levenberg–Marquardt* achieves a classification accuracy of 100% with least number of ICA features.

Wafaa Alakwaa, Mohammad Nassef, Amr Badr, Lung Cancer Detection: A Deep Learning Approach [8]

Pre-processing techniques is used to highlight lung regions vulnerable to cancer and extract features using UNet and ResNet models. The feature set is fed into multiple classifiers viz., XGBoost and Random Forest and the individual predictions are ensembled to predict the likelihood of a CT scan being cancerous. The accuracy achieved is 84% on LIDCIRDI out-performing previous attempts.

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III. METHODOLOGY

There are two steps for diagnosis of lung cancer. The first step is the detection task and second step is classification task. Abnormality of lung will be detected in the detection task. After detecting abnormality of the lung, the radiologist can take the proper action for solution. Following figure show the common steps for the lung cancer detection [7] .

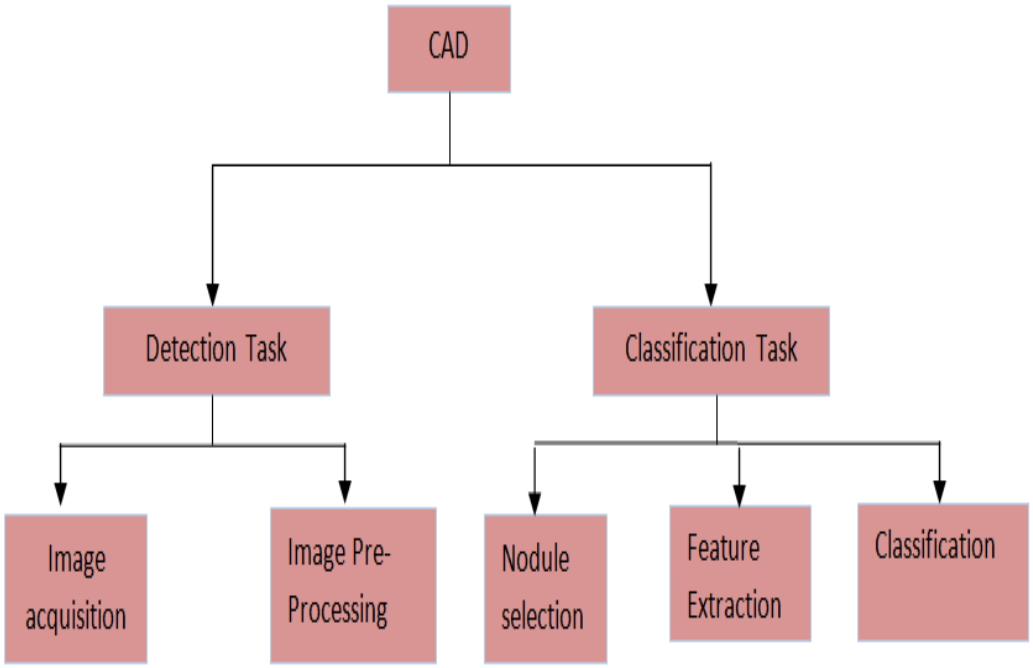


Fig 2 .Methodology Of Lung Cancer Detection [7]

A. Image Acquisition

In image acquisition the number of CT images and slice of each image are given as an input in CAD system for training and testing purpose. Malignant or benign both the images are use in image acquisition. Based on the malignant and benign images of CT scan we can perform the feature extraction easily. Due to privacy problem all the hospitals maintain the recored of medical images.

B. Image Preprocessing

Main process of lung cancer detection is the image preprocessing because in this process all the unwanted information is removed from the original images. In this preprocessing we can perform the following task like edge detection, Morphological operations, noise removal methods mainly used for pre-processing of images.

C. Nodule Selection

After completion of preprocessing of lung image the next step is to find the lung nodules from the lung images. For detecting the nodules from the lung images number of segmentation method like region growing are used.

D. Feature extraction

The result of the nodule selection can be classified into two different categories either it is benign nodules or it is malignant nodules. Both the nodules are responsible for the lung cancer. In feature extraction process nodules are differentiate in two categories like 1) non-nodules (vessels, benign nodules, airways etc.) and 2) nodules (Actual cancerous regions)

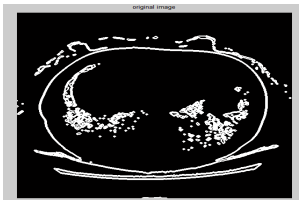
IV. DATASET DESCRIPTION

In most research work, Kaggle and LIDC dataset is used. LIDC dataset contain 1397 CT scan and 24850 slices. Multiple slices are used for each CT scan image and each scan with multiple variable of 2D slices. In each data labels are used like (0 for no cancer and 1 for cancer). In Kaggle dataset this kind of label are not provided. Normally the CT scan images are in the form of 512*512 pixels. All 500 images are use for training and testing purpose.

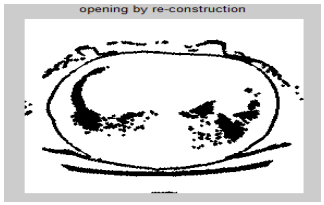
V. RESULT ANANLYSIS

The main reason for selecting image in dicom format because dicom image can contain number of information like patient ID, slice thickness and mostly it is freely available in Kaggle site. From the literature review of the number of papers, it is analyzed that the CNN outer performs the other methods.

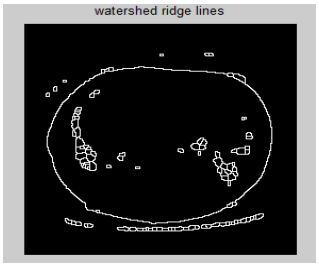
Original Image



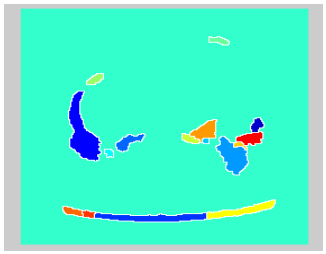
Re-Constructed Image



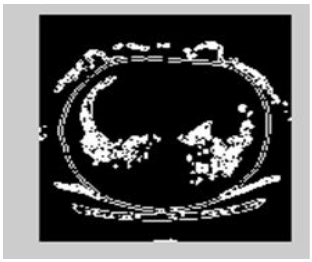
Watershed Image



Acquisition Image



Binary Image



Inverted Image

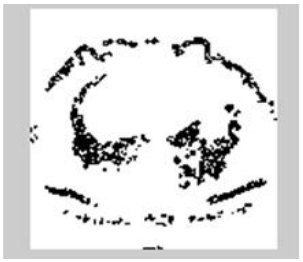


Fig3. Out-put of Existing System

VI. CONCLUTION

In this review paper, the different methods of lung cancer detection are discussed. This research can give the basic overview for detection of lung cancer, and can help to identify best methods for lung cancer detection. Because day by day the lung cancer detection techniques are improved, all these techniques have some disadvantages. As per the literature review and different authors, CNN is the best method for lung cancer detection.

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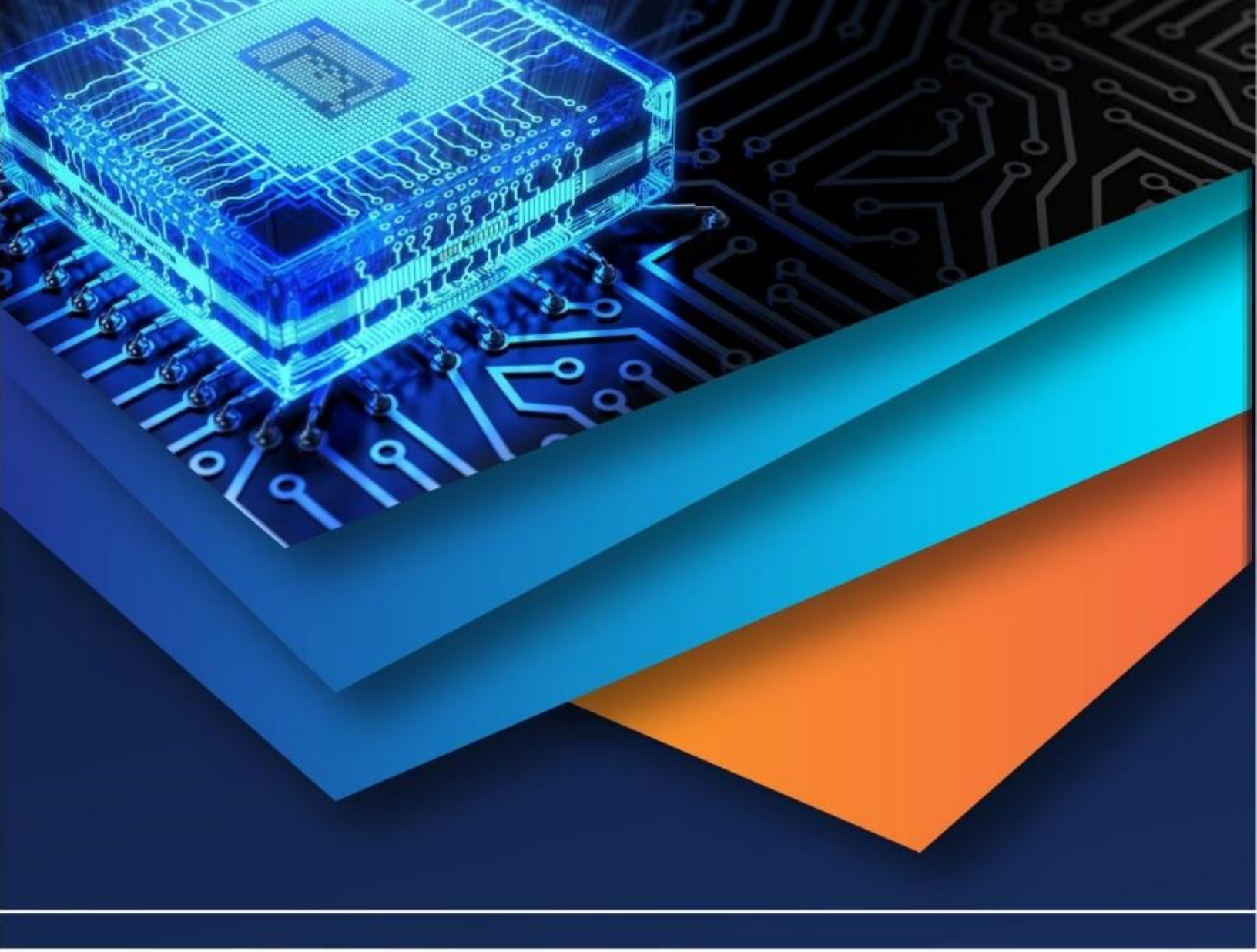

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