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IMAGE PROCESSING FOR DETECTION OF LUNG CANCER: A REVIEW

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Abstract**:** *Lung cancer is the deadly and widespread cancer in the globe. Cancer detection is still difficult for doctors due to the discovery of cancer cells in the lungs. So, early detection of disease is required to avoid seriously advanced stages and reduce the mortality rate. This paper examines the various techniques of detection of lung cancer using image processing. Image quality and accuracy are the main factors of this research.*

In recent times, image processing techniques have been widely used in several medical fields for image improvement in earlier detection and treatment stages, where time is important to discovering abnormality issues in target images, particularly in various cancer tumours such as lung cancer, breast cancer, and others. This paper provides an overview of the various techniques used by authors to detect lung nodule in Computed tomography images.

Index Terms *- Literature review, CT Images, Lung cancer, Image processing, etc.*

INTRODUCTION

At present, medical imaging analysis becomes more popular in the medicinal field, especially in non-invasive treatment and clinical inspection. The gathered restorative images like computer tomography (ct), x-rays, ultrasound imaging, and so on are applied for detailed diagnosis. Among the medical imaging methods, ct is an important filtering approach that utilizes the interesting domains for capturing images. A study shown that lung cancer is an vital reason which results in the death rate of 1.61 million deaths annually. Another study revealed that the chance of survival gets increased when cancer gets identified at an earlier level. Lung cancer is the second major disease ranked second position among males and tenth position among females globally. The prior detection of lung cancer is not an easier process. Almost, 80% of the patients are identified efficiently at the moderate or earlier stage of cancer. There is a greater need to design an efficient classification model to detect the existence of lung cancer.

Lung cancer is one of the dangerous and life-taking diseases in the world. However, early diagnosis and treatment can save a life. Although CT scan imaging is the best imaging technique in the medical field, it's difficult for doctors to interpret and identify cancer from ct scan images. Therefore computer-aided diagnosis can be helpful for doctors to identify the cancerous cells accurately [3]. The number of deaths caused by lung cancer in the lungs exceeds the total number of deaths caused by prostate, colon, and breast cancer combined. Looking at the current situation where we are fighting a disease like a corona which has a lot of lung involvement. Cancer patients are at increased risk of covid-1 infection. In some reports, it has been described that how patients with non-small cell lung cancer have a higher incidence and severity of the disease.

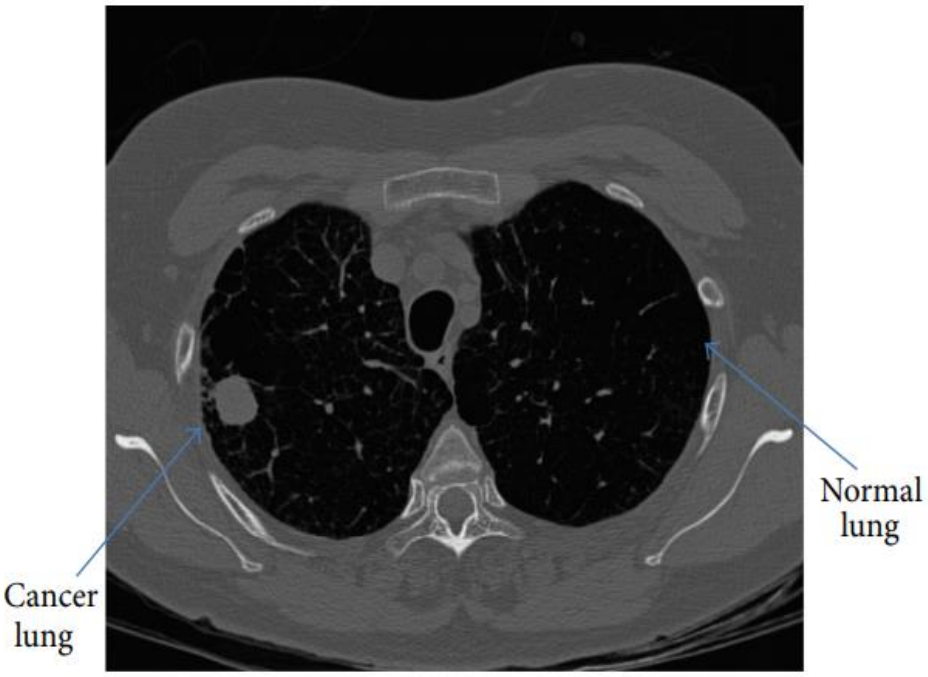

FIG1.1: CT SCAN IMAGE OF LUNG CANCER [2]

Cancer is a disorder in which the body's cells grow and divide quickly. When cancer starts within the lungs it's a carcinoma or lung cancer. Lung cancer implies the leading reason behind cancer death and also the second most diagnosed cancer in both males and females in the United States. After increasing for numerous years, carcinoma rates are decreasing nationally, as fewer people smoke cigarettes. Cigarette smoking is the foremost reason behind lung cancer or carcinoma. Lung cancer can also be caused by using other sorts of tobacco (such as pipes or cigars), breathing second-hand smoke, being exposed to substances like asbestos or radon at home or work, and having a case history of lung cancer. There are two kinds of lung cancer: 1.Small cell lung cancer (SCLC). 2. Non-little cell lung cancer (NSLC)[9] the size of the tumor shows the arranging of the malignant growth in the lung hubs. There are absolute four phases of the cellular breakdown in the lungs in which, if the tumor is in the first or the subsequent stage, it very well may be recovered. If the tumor is in the third phase of the disease it is hard to recuperate. The extremely risky stage is the fourth stage, in which there are no odds to eliminate the lung tumor because the cells of the malignant growth are spread all the piece of the body which is exceptionally hard to recover.

Lung cancer detection is processed in different stages such as pre-processing, segmentation, feature extraction, and classification. Generally, there are four phases to determining whether or not you have lung cancer. The first phase entails obtaining CT scan imaging data. In the second phase, picture enhancement or pre-processing to improve the image quality. Image segmentation is the third phase, and it is a crucial stage in cancer detection. The fourth stage is feature extraction, which determines whether or not there is lung cancer.fig 1.2 shows the generalized phases of cancer detection.

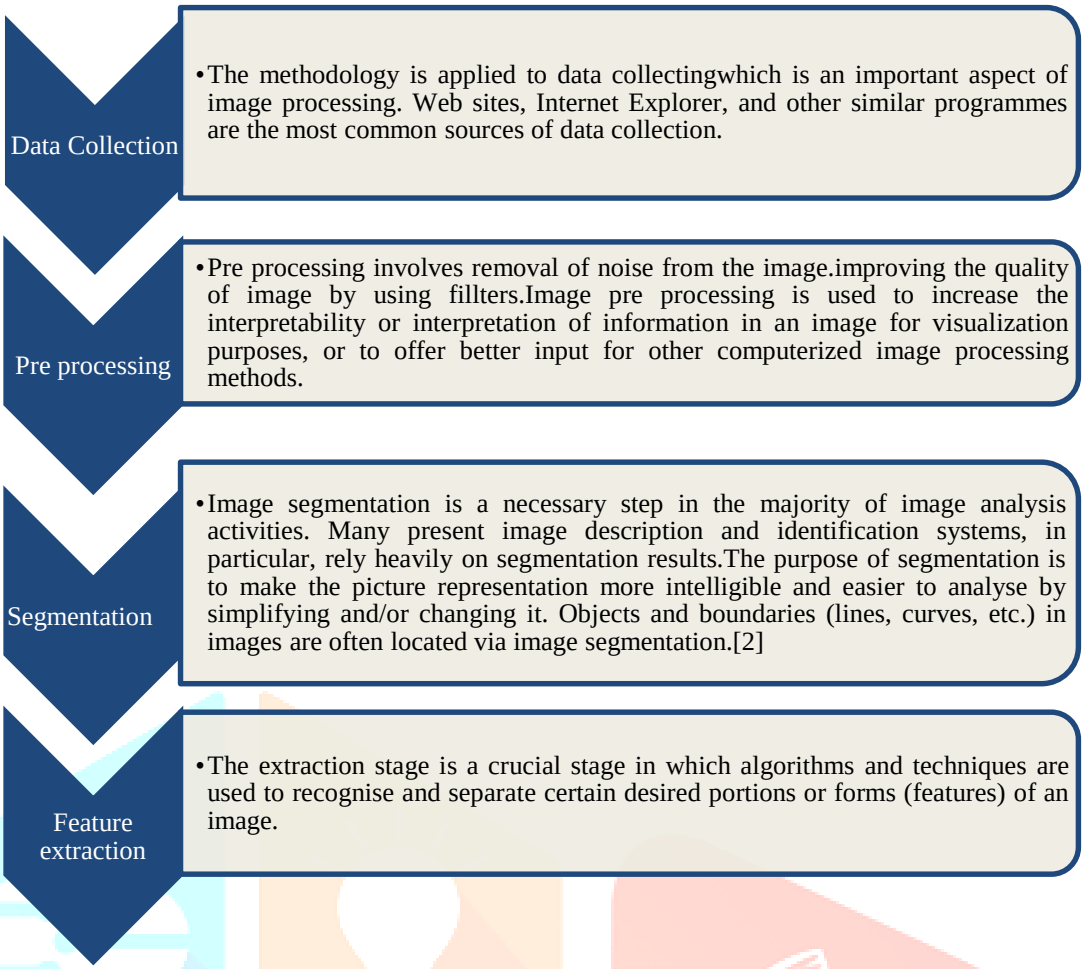

FIG1.1: CT SCAN IMAGE OF LUNG CANCER

RELATED WORK

There was a substantial amount of research on the detection of lung cancer. Also relevant to this paper is previous work that examines various techniques of image processing for the detection of lung cancer. The existing literature on the detection of lung cancer using various image processing techniques is reviewed in this chapter.

Nidhi Nadkarni et.al. [1] Presented an automated approach for the detection of lung cancer in ct scan images. Using methods such as median filtering, an algorithm for lung cancer detection is suggested. for image pre-processing followed by segmentation of lung region of interest using mathematical morphological operations. Geometrical features are computed from the extracted region of interest and used to classify CT scan images into normal and abnormal by using a support vector machine.

Altarawneh et.al [2] an image improvement technique is developing for earlier disease detection and treatment stages; the time factor was taken into account to discover the abnormality issues in target images. Image quality and accuracy were the core factors of this research. Low-pre-processing approaches based on the Gabor filter within Gaussian rules were used for image analysis and enhancement. The proposed methodology is effective for using segmentation principles as a platform for getting feature extraction. In comparison to existing strategies, the proposed methodology yields very promising outcomes. A normal comparison is done based on general characteristics. Pixel percentage and mask-labeling with high precision and sturdy operation are the major identified features for reliable picture comparison.

Suren Makaju et. Al. [3] has a main aim of this research is to evaluate the various computer-aided techniques, analyzing the current best technique and finding out their limitation and drawbacks, and finally proposing a new model with improvements in the current best model. The method employed was to sort and evaluate lung cancer detection approaches depending on their prediction performance.

Bariqi Abdillah et. Al. [4] implements and analyzed the image processing method for the detection of lung cancer. Image processing techniques are frequently utilized for picture improvement in the detection phase to enable early medical therapy in a variety of medical issues. This study proposes an image segmentation-based lung cancer detection approach. Image segmentation is a level of image processing that is intermediate. To a part of the Ct images, a marker control watershed and region growing

strategy was employed. Following the detection phases, image enhancement with the Gabor filter, picture segmentation, and feature extraction are performed. They discovered the usefulness of their strategy based on the experimental results. The results reveal that the watershed with masking method is the best strategy for primary feature detection.

Santosh Singh et. al. [5] proposed a semi-automated segmentation method to segment lung nodules from ct images which can successfully segment a nodule provided that the parameters are set properly. In this study, histogram equalization is used to modify the image so that its histogram has desired shape. The purpose of histogram equalisation is to provide consistency, which allows for more visually pleasing results. This study aims to provide systematic and quantitative measurement on ct images so that physicians can diagnose the nodule more effectively and more accurately. By this work, the acquired results are satisfactory to detect the nodule.

Miah et.al [6] detection of lung cancer from ct images using image processing and neural network. In proposed strategy seek after methodologies in which the initial step is parallel thresholding, and afterward, include extraction, and afterward, these highlights are utilized to prepare up the neural organization and test the neural organization. The proposed framework effectively recognizes the cellular breakdown in the lungs from ct examine pictures. regularly an uncommon kind of computerized x-beam machine is utilized to obtain point-by-point pictures or outputs of territories inside the body called electronic tomography (ct).in feature extraction morphology operations are used to extract the features like shape, colors, size, etc. Dilation and erosion are the basic functions of morphology. Opening and closing functions using dilation and erosion morphology functions applied on the ct images .basically dilation expands the object's boundary and erosion shrinks the object.

Sivakumar et.al. [7] develop an efficient lung nodule detection scheme by performing nodule segmentation through weighted fuzzy-based clustering is carried out for lung cancer images. Support vector machine (SVM), a machine learning technique is used for classification. The RBF kernel-based SVM classifier performs better than linear and polynomial kernel-based classifier.

Jayaraj, D. Et.al. [8] proposed a random forest-based classification model for lung cancer prediction on computer tomography images. In this research two convolutions neural organization (CNN)-based models were proposed as profound learning techniques to analyze cellular breakdown in the lungs on ct lung images. For this profound learning as a successful territory of AI strategies by utilizing programmed include extraction techniques could limit the interaction of highlight extraction**.**

[9]Neelima Singh and A. Asuntha, “image processing used for lung cancer detection in medical imaging “in this paper lung CT, X-Ray and Ultrasound pictures utilized were gotten from expert clinical imaging community. The picture upgrade is finished utilizing the Gabor channel.

The research presented above shows the different techniques and methods are available for detecting lung cancer using an image processing mechanism. The paper focuses on briefing up various approaches proposed by different authors for the segmentation of lung nodules for the early detection and diagnosis of lung cancer which could benefit in minimizing the death rate caused by malignant lung cancer. It is difficult to detect because it arises and shows symptoms in the final stage. Early discovery and treatment of the condition, on the other hand, can minimize the mortality rate and probability.

In the majority of papers, the Gabor filter with Gaussian rules was used to pre-process the image before segmentation and feature extraction. In this study, described that the marked watershed segmentation (85.165%) has more accuracy than the thresholding approach (81.835%)[2][4].

In [5] Santosh Singh et.al. Proposed to use histogram equalization with the morphological operations. The goal of this research is to provide a systematic evaluation of ct images so that professionals can diagnose nodules more effectively and accurately also increases the efficiency of the CAD system. In [9]the author described the use of a superpixel algorithm for segmentation on the CT, MRI, and Ultra Sound Images.

In [1][7]authors affirm that a support vector machine (SVM) is used for the classification of normal and cancerous images. In the same context, the SVM algorithm is used for the classification and in pre-processing median and Gabor filters are used to smoothen the images[3]. Nevertheless in the study by Jayaraj, D. The obtained experimental results demonstrated that the presented model performed exceptionally well as a classifier on an applied dataset. In this exception, a model is used to extract features and an RF classifier is used to identify ct lung images which deliver the sensitivity of 96.56 and specificity of 98.25[8].

TECHNIQUES USED FOR DETECTION:

Ref no.	Year	Methods used	Findings
[10]	2021	Principal component analysis algorithm used to classify the target classes. Support vector machine used for additional classification.	Precision, recall, f1-score given by the classification method. Accuracy and error rate calculated by confusion matrix 0.87 and 0.3 resp.
[12]	2021	For improvement in segmentation Fuzzy c-means, BAT optimization algorithm with Convolution Neural Network used to get better classification result.	Accuracy of 97.43 % with the least amount error of 2.57 % achieved.
.[13]	2020	Otsu's thresholding and k-Means clustering segmentation approaches were used with a median filter.	It is observed that Otsu's segmentation algorithm delivers the best result on CT and MRI images as compared to an X-Ray image
[14]	2020	Deep Convolution Neural Network used for classification with adaptive median filter for image enhancement.	Deep learning CNN delivers a good result for classification.
[15]	2019	Improved profuse clustering technique**,** deep learning instantaneously trained neural network.	Quality is enhanced by computing the weighted mean function that replaces the pixel by a probability distribution and cumulative distribution process. It delivers 8.42% of accuracy with an error of 0.038.
[16]	2018	Marker-controlled watershed and threshold approach used for segmentation, SVM multi classifier. GLCM (Gray Level Co-Occurrence Method) technique for arranging pixel brightness values.	The multi-stage classification is used for getting a more accurate result. Delivers 87% accuracy in cancer detection and precision of 97%. Watershed segmentation addresses the problem of neighbourhood minimization.
[17]	2019	Linear discriminate analysis with Deep neural network, Modified Gravitational Search Algorithm used for identification of lung cancer in the classification.	Linear Discriminate Analysis is used for feature reduction to minimize the cost and reduce time consumption. results gives the sensitivity 96.2%, specificity 94.2%, and accuracy of 94.56%
[18]	2016	Hopfield Neural Network (HNN), Fuzzy C-Mean Clustering Algorithm (FCM), Thresholding algorithm.	Hopfield neural networks provide better-detailed performance when compared with fuzzy c mean clustering. FCM is less insensitive to intensity fluctuations as compared to HNN.
[19]	2011	Denoising, Wiener filtering in pre-processing, Sobel Edge Detection Method, region growing, ridge detection, morphological operations.	Sobel edge detection gives good accuracy in the smoothing process. It can detect lung nodule >3mm.Reduced false detection with 90% sensitivity 0.05 false positives per picture.

Table 1.1: Techniques used in image processing for detection of lung cancer.

CONCLUSION:

Lung cancer is the leading cause of death all over the world, curable if detects in the early stage. In the arena of lung cancer diagnosis, computer-aided diagnostic (CAD) systems are effective schemes that have been designed for the detection and CAD characterization of diverse lesions. The development of automated CAD systems for lung cancer is becoming increasingly important to researchers.

Research addressing a system for automatic detection of lung cancer in ct images is developed using image processing and machine learning technique. The existing methods are not computationally fast and adaptive. Most algorithms are based on the clustering approach. In which, the fuzzy c-means technique separates the image into different clusters, but each time the cluster changes its place while running the program which means the system can't call the particular image at all-time that leads to giving the wrong output. This segmentation is going to segment not only the cancer parts alone but segment the background also leads to wrong calculations of cancer area. Also, some author has implemented it using deep learning. The deep learning techniques need more advanced hardware requirements leads to more cost. Therefore, there is a need to develop such a method that removes the drawbacks of an existing system to get classify the perfect lung cancer region with less execution time. After examined all the methods noticed that various methods gave various levels of efficiency. Lung cancer is the leading cause of death all over the world .it is curable if detects in the early stage. For future studies, we can use Image Processing Techniques to improve the accuracy of X-ray and MRI pictures. K-mean or fuzzy c-mean clustering can also be utilized for categorization. Moreover, For a better lung cancer detection result, a comparison of X-ray and CT scan pictures can be made. The CAD system not only improves detection outcomes but also reduces human intervention.

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