AI Based Computer-Aided Detection Model for Lung Disease Prediction

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Lung illness is the most common cause of the enormous number of deaths that occur worldwide. It is not an easy process to identify lung malignant growths prematurely. There are several imaging modalities that can be used to find lung cancer. For radiologists, computer-aided diagnosis systems are very helpful in detecting and recognising irregularities earlier and more quickly. The primary goal of the CAD systems is to locate and diagnose lung nodules. Since the course of treatment is contingent upon the stage of the cancer, it is imperative to stage lung cancer as soon as it is discovered. The primary goal of the proposed work is to identify the lung nodule from the CT scan and categorise it as cancerous or non-cancerous so that the cancer can be located more accurately, sensitivity, and specificity than with existing methods.

Keywords: Health, AI, Disease. Prediction. CAD.

1. Introduction

One of the major cause’s deaths through cancer is Lung cancer. It's hard to identify since in the final stage it occurs and exhibits symptoms Moreover, through initial identification and treatment of the disease, mortality rate and risk can be decreasing [6]. The ability of the best CT imaging technology to detect both abnormal and normal lung cancer nodules makes it useful for diagnosis [1]. However, inconsistent CT scan brightness and incorrect anatomical structure interpretation by radiologist and doctor can make it difficult to identify the cancer cell [2]. Computer Aided Diagnosis has emerged as a useful adjunct to radiologists and physicians in assisting with accurate cancer detection [11]. Many systems have been developed and research has been under way to detect lung cancer [9]. On the other hand certain models do not have sufficient detection accuracy and certain model still need to be developed in order to achieve the maximum accuracy of 100%. Numerous scientists have suggested and introduced lung cancer identification models using various imaging and machine learning methods [3].There are various segmentation concepts [4] involved in detecting cancer cells from normal cells. Region based Segmentation [5], Edge based technique [12], thresholding technique [7]. The various classification method based on Neural Network Classifier [8], Decision Classifier [14][13].

Here is a description of the work: Section 1 presents an overview of the topic and includes studies from multiple research articles. Part 2 outlines the recommended approach, while Part 3 defines performance criteria. The research findings are presented in Part 4, and Part 5 concludes the effort.

2. Methodology

A computer-aided automatic detection system is the suggested approach for lung disease detection. Figure 1 shows the general process for the detecting technique. The initial preprocessing of the original CT picture involves applying an image enhancement technique using BADF, and the optimised Chan-vese algorithm is then used to segment the enhanced image. After that, using 3D-CNN architectures based on deep learning, a neural network classifier is trained to distinguish between normal and abnormal images by comparing them to the taught features. Lastly, an analysis is done on the lung CT image classification's performance.

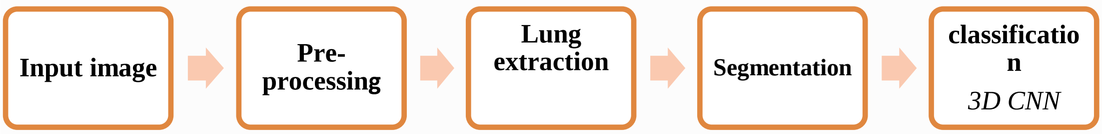


Figure 1: Overall, View of Proposed Work

The boundaries and outlines of the related equipment are displayed using the morphological procedures and clever edge detector. An inventive adaptive concave hull approach is applied to achieve certain initial lung masks. Convex and concave hulls are widely utilised and useful for a variety of research applications in a variety of fields. The concave hull model offers better performance than the convex hull model. The known value of the convex hull procedure is used to calculate the concave hull, and a dig must be done to produce a concave hull with the appropriate profundity. Recently, segmentation has become a crucial challenge for image inquiry and interpretation in medical image analysis. Segmenting lung tumours from computer tomography pictures is a major task. In this case, region-based active contour models and k-means clustering are intended for use.·

CNNs are mostly used for deep neural networks. This consists of several nonlinear levels of operation, such as neural networks with many hidden layers [10]. It can view images and frames from the film. CNNs learn the connections between pixels in the input image by extracting reflective attributes through pooling and convolution methods. The characteristics of each layer utilizing trained kernels differ in complexity, with simple elements like the edges extracted in the first layer and high level features extracted in the later layers.

The contribution of each variable can be expressed and contributed independently thanks to the cFhain rule.:

$$\frac{\partial e}{\partial x^{\ell}_{i,j,k}} = \frac{\partial e}{\partial y^{\ell}_{i,j,k}} \frac{\partial f(y^{l}_{i,j,k})}{\partial y^{\ell}_{i,j,k}} = \frac{\partial e}{\partial y^{\ell}_{i,j,k}} f'(x^{l}_{i,j,k}) \qquad (1)$$

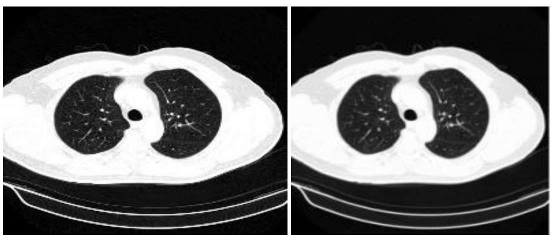
The following equation can be used to modify the weights in the previous convolution layers by repeating the error to those layers:

$$\begin{aligned} \frac{\partial e}{\partial y^{\ell-1}_{i,j,k}} &= \sum_{a=0}^{n1-1} \sum_{b=0}^{n2-1} \sum_{c=0}^{n3-1} \frac{\partial e}{\partial x'_{(i-a),(j-b),Uk-c)}} \frac{\partial x^{\ell}_{(i-a)(j-b)(j-b)}}{\partial y^{\ell-1}_{i,j,k}} \\ &= \sum_{a=0}^{n1-1} \sum_{a=0}^{nz-1} \sum_{b=0}^{n3-1} \frac{\partial e}{\partial x^{T}_{(i-a)(j-b),(k-c)}} \omega_{a,b,c^*} \end{aligned} \qquad (2)$$

The equation above can be used to calculate the error for the previous layer. Moreover, the equation above is valid for n locations on each side of the data. By adding nulls on each side of the input volume, this problem can be eliminated.

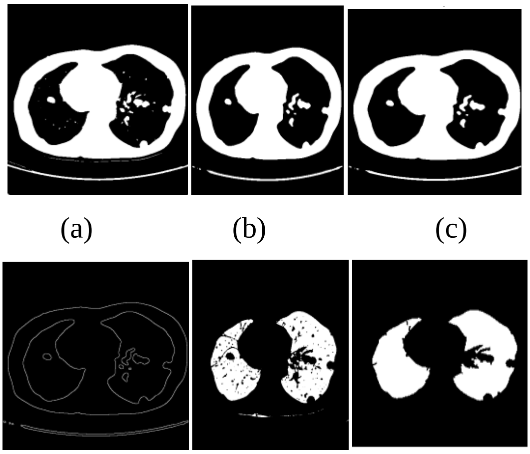
3. Experimental Results & Discussion

The benign and malignant lung cancer samples used in this proposed work are derived from publicly accessible LIDC databases. These CT scans of the lungs are taken into account when classifying patients in order to determine their disease stage. Three samples of each category's output are displayed in this chapter out of the 75 samples that were obtained for each category. 2018a is the version of MATLAB used to process these photos. In this work, a 3D-CNN classifier is used to recognise and classify the photos of lung cancer. This contributes to improving the classification method and yielding 97.3% accuracy.



(a) (b)

Figure: 2 (a) Input Image (b) Preprocessed Image

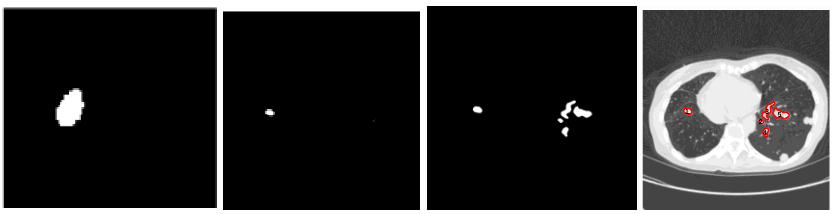


(a) (b) (c)

(d) (e) (f)

Figure 3: (a) Fuzzy Thresholding Result (b) Erosion Result, (c) Dilated Result, (d) Result of Canny Detector , (e) Result of Image Without Border (f) Result of Adaptive Concave Hull

Figure 2 illustrates the steps involved in preparing lung images. Here, the irrelevant elements have been removed, and the image features have been enhanced. Figure 3 shows the outcome of image binarization and lung extraction.



(a) (b) (c) (d)

Figure 4: Result of Segmentation (a) K-means Clustering (b) Region Based Active Contour (c & d) Final Result of Proposed Optimized Chan-Vese and Labeled Image

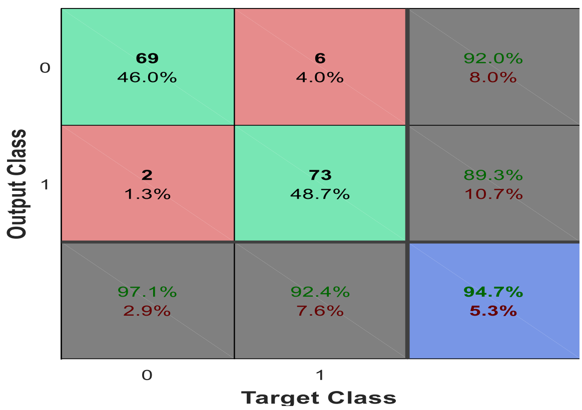


Figure 5: Confusion matrix of 3D-CNN

Figure 5 illustrates the 94.7% accuracy of the proposed classifier that was acquired. Table 1 displays the suggested accuracy, sensitivity, and specificity performance metrics when compared to the current model.

Table 1: Performance Comparison

References	Accuracy	Sensitivity	Specificity
CNN	93.01	89.13	96.8
RNN	91.02	92.7	89.05
ANN	91.95	89.5	93.8
DBN	92	90.9	93
NN	91.41	89.06	93.75
Proposed-3D-CNN	97.7	95.3	96.8

4. Conclusion

Screening is necessary for those who have been impacted by lung tumours in order to prevent mortality. The abnormalities seen in the lung are identified by the application of sophisticated detection algorithms and medical image processing techniques. The suggested system uses a variety of image processing methods and classification algorithms to automatically detect lung tumours. The suggested method classifies lung cancer into several phases. The sensitivity, specificity, and accuracy of the 3D-CNN classifier—which is used to identify the stages of lung cancer—are calculated, assessed, and contrasted with those of other suggested techniques. When compared to other suggested strategies, better outcomes are achieved. 97.7% accuracy is achieved by the suggested classifier.

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