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Lung Cancer Detection Using Deep Neural Networks: A Review

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Abstract:
Background*: Lung cancer keeps on changing on various medical factors depending on topographic areas. The identification of Lung cancer at initial stages is of extreme importance if it is intended to degrade high mortality rate. The worldwide lung screening program focuses to imagine PET/CT examinations amongst most matured gatherings at danger to upgrade the early location rate. In spite of the fact that utilization of obtrusive procedures, side effects scarcely show up until infection is propelled making it troublesome for radiologist to recognize sores. Every year, the American Cancer Society appraises the quantities of new growth cases and passing that will happen in the world in the present year and aggregates the latest information on tumor frequency, mortality, and survival. Genuine and precise information is the basis of disease control initiatives.*
Results: *This strategy is more about diagnosing at ahead of schedule and critical stages with keen computational procedures with different noise elimination by segmentation strategies and calculations which is the root idea of digital image processing. Location of CT pictures received from cancer research organizations is investigated utilizing MATLAB*
Key Word*: Magnetic Resonance Imaging (MRI), Convolutional Neural Network (CNN), Lung cancer.*

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I. Introduction

Tumor is a noteworthy general health issue worldwide and is the second driving reason for death all over the world, regardless of age. Cancer can be clarified as uncontrolled cell development having capacity to spread everywhere throughout the body. Our body contains red blood cells (RBC's) as well as white blood cells (WBC's). The main function is to supply fresh oxygen (02) to all parts of the body with the help of blood flow, due to which blood appears red. [1] In the lungs, tissue receives oxygen (02) because of RBC's only. The hereditary substance of erythrocytes has high centralization of hemoglobin. The cell film comprises of proteins and lipids which is spine of physiological cell capacity. They don't contain any imperative piece of cell, which incorporates hemoglobin. Around 20 lakhs new RBC's are created every second. [2] The cells are delivered in the bone marrow and turn all through the body for around 4 months to an fro in arteries and veins.

Image processing is utilized to break down pictures at the most reduced level gave any quality. These operations don't amplify probability of data content, however they diminish it if entropy is a data measure. The principle necessity of preparing is to enhance pixel power by changing over from discrete to computerized picture, sectioning to pixels, completing numerical operations on pixels, and recreating of picture with better quality. [11] Pre-processing of CT pictures is the underlying stride in picture examination took after by division handle and finished with some morphological operations are connected to recognize the tumor spots/cells in the picture. Likewise it can be utilized to decide the measure of spreading of malignancy i.e. what proportion of lung is influenced wit disease. The morphological operations are essentially connected by looking at the size and state of the malignancy cell with ordinary cell, and after that the contaminated cells pictures showed onto dim scale picture with greatest intensity. Latest developments in Deep Learning and Deep Neural Networks facilitate the process of image recognition. Using Deep Neural Networks we can search for patterns in an image and determine if we recognize the pattern or not or we can search for multiple patterns and as a result get which pattern was recognized. Training the Neural Network requires a dataset that is predetermined which the Network can use to learn to recognize. Deep neural networks are becoming more and more popular as they can be applied to image pattern recognition and image classification.

II. Related Work

- Priyanka Kamra et al [1], compares different lung nodule segmentation methods. The paper compares iterative thresholding and Fuzzy region-based level set methods. A dataset of 52 patients was used and 82.7 % of True positive ratio was achieved.

- Negar Mirderikvand et al [2], proposed an automatic localization of lung nodules. It uses Graph cut and snake algorithm on the 27 CT scans from the LIDC database and achieved a 100 % true positive rate.
- Qui Shi et al [3] proposed a lung nodule detection method using Gesalt based algorithm. The method segments the lung region from the CT image first. Then, local three-dimensional data were incorporated to the maximum intensity projection image taken from sagittal, axial and coronal planes. 50 scans from the ELCAP public database is used and an accuracy of 91.29 % was achieved.
- Sara Soltaninejad et al. [4] proposed a robust lung segmentation by combining active contours with adaptive concave hulls. It used CT scans from the TABA medical imagining center of Shiraz medical school and from ANODE09. It gave an accuracy of 95.9 %, sensitivity of 90.1% and specificity of 97.6 %. In the proposed method, adaptive thresholding and watershed segmentation technique are used to detect lung nodules in the 50 CT scan images.
- Shukla et al (2009) proposed a novel technique to simulate a Knowledge Based System for diagnosis of Breast Cancer using Soft Computing tools like Artificial Neural Networks (ANNs) and Neuro Fuzzy31 Systems. The feed-forward neural network has been trained using three ANN algorithms namely Back Propagation Algorithm, Radial Basis Function (RBF) Networks and the Learning Vector Quantization (LVQ) Networks. Adaptive Neuro Fuzzy Inference System (ANFIS). The simulation was done using MATLAB and performance was evaluated by considering the metrics like accuracy of diagnosis, training time, number of neurons, number of epochs etc., and these parameters can be very effective for early detection of Lung Cancer.

III. Proposed Methodology

The methodology adopted in this project was carried out in five steps which are shown with the help of a flow chart in Fig.1. Each step of the flow chart is explained below:

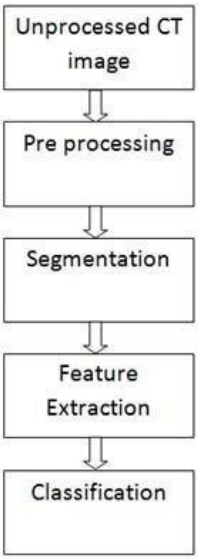

Fig.1 Methodology Block Diagram

1) Data collection

The CT images of lungs acquired from the hospital database are shown in Fig.2. We will analyze how this algorithm helps us to distinguish between cancerous and non-cancerous images.

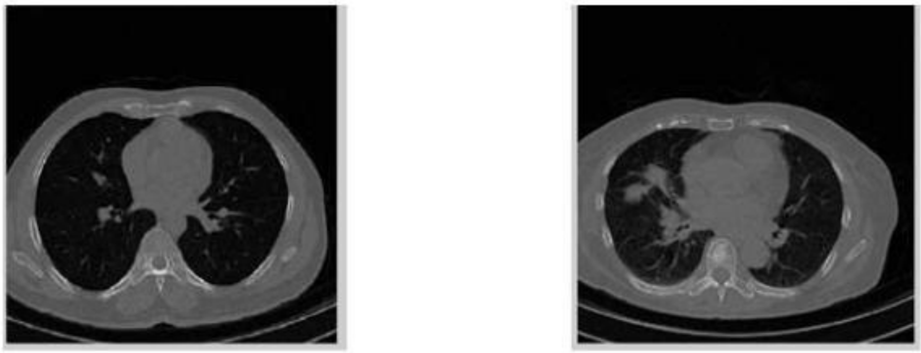

Fig.2 .a. Non- cancerous image b. Cancerous image

2) Pre-processing

Preprocessing involved the steps shown in Fig.2.

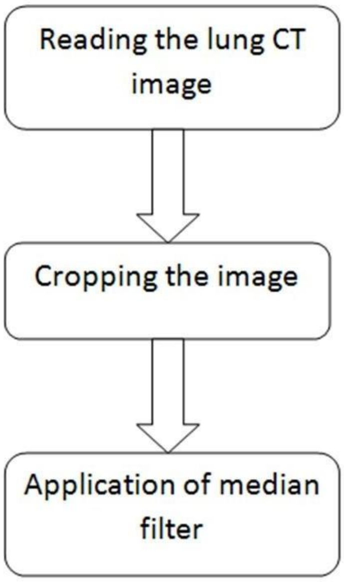

Fig.2 Pre-processing flow diagram

Cropping of the image in first step is done to eliminate the unwanted portions from the image. Next, median filters are applied to the images, which are basically used to get rid of the salt and pepper noise present in the images. A median filter of size 3*3 was used and its contribution towards enhancement of the images is shown in Fig.3.

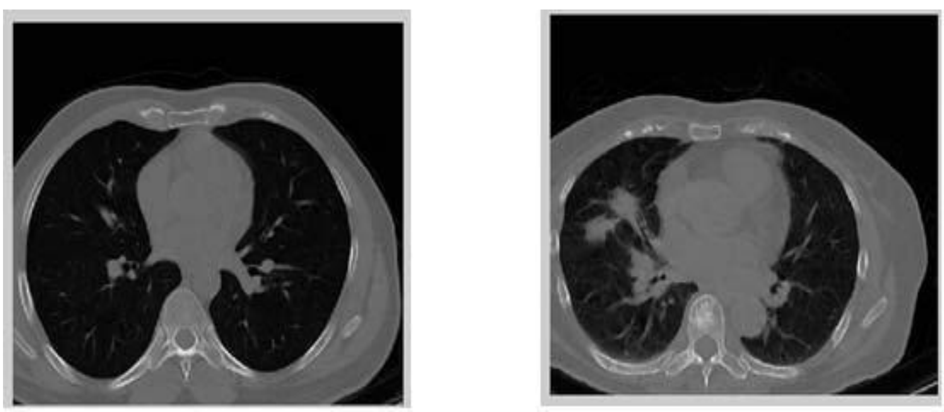

Fig. 3 Median filtered images

3) Segmentation

Segmentation steps are depicted in flow diagram, shown in Fig.4. and each step is discussed in detail. Converting the images to binary reduces computational complexity and storage issues and also is a pre-requisite for morphological segmentation of lungs. The opening operation using the periodicline structuring element tends to remove some of the foreground pixels from the edges of the region of foreground pixels.

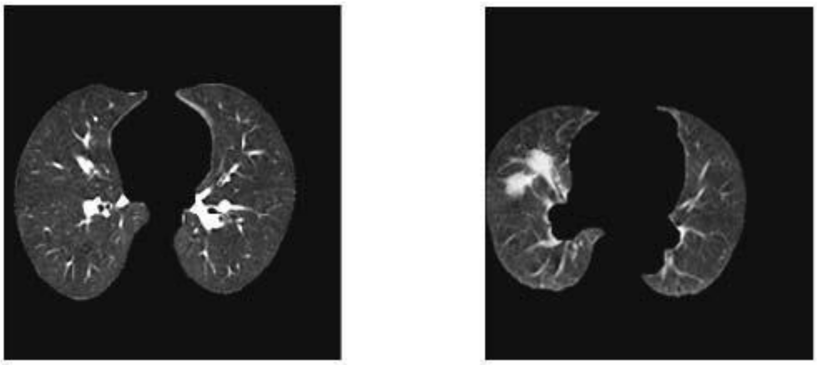

Fig. 4 Segmented Lungs

IV. Convolutional Neural Network (CNN)

CNN is a class of Deep learning neural network, and it works by extracting features from the images. CNN consists of Convolution Layer, Rectified Linear Unit (ReLU) layer, pooling layer and fully connected layer.

Convolution layer is the core and primary layer in CNN which focuses to extract features from the input. Convolution performs linear transformation of input data preserving spatial information of data and then this layer divides input image into smaller regions (can be called as feature maps) it convolves the input and provides output to the next layer.

ReLU layer applies activation function to increase the non-linearity without affecting fields of convolution layers. CNN uses Pooling layer as down-sampling method. It reduces the dimensions of feature maps received from the previous layer. In short, pooling layer summarizes the feature present in the feature map generated by convolution layer. Fully connected layer means each neuron in the preceding layer is connected to each neuron in the adjacent layer. The high-level features of the input image is obtained from convolution, ReLU and pooling layer. The main purpose of Fully connected layer is to use these extracted features for image segmentation based on the provided training dataset.

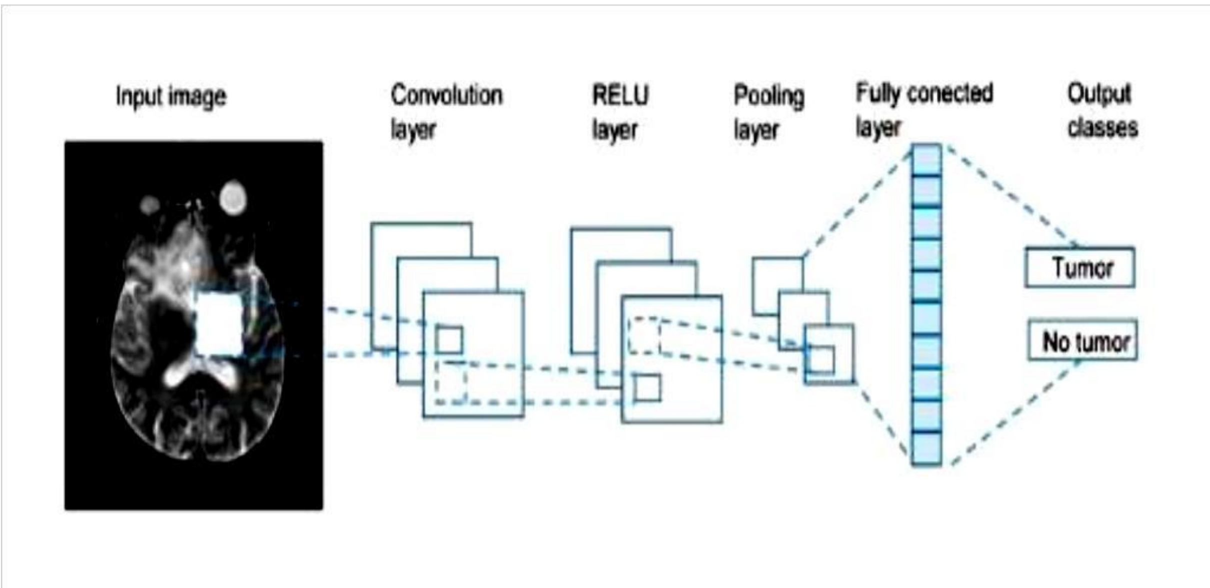

FIGURE 3. Convolutional Neural Network

V. Performance Evaluation

The performance evaluation of this approach can be estimated based on sensitivity, specificity and accuracy
Sensitivity = TP / (TP + FN)
Specificity = TN / (TN + FP)
Accuracy = (TP + TN) / (TP + FP + TN + FN)
The true positives (TPs) identified by this approach was 94 and hence the sensitivity was reported as 76.42% (94/123). The number of false positives (FPs) was 38 and hence the specificity was reported as 78.53 % (139/177). Accuracy was estimated as 77.67% (233/300)

VI. Conclusion

The proposed method is evaluated on the publicly available Lung Image Database Consortium and Image Database Resource Initiative (LIDC/IDRI) dataset. Results indicate that our proposed method can successfully segment nodules and achieves the average Dice scores of 94.97%, and Jaccard index of 88.68% which is significantly higher than other state of the art methods, also this method successfully segment all challenging cases including pleural nodules.

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