DETECTION OF LUNG NODULES BY CNN APPROACH IN CT IMAGES: A REVIEW

Sayana Sharma[1], Mandeep Kaur[2], Deepak Saini[3]

Department of Electronics and Communication, Punjabi university, Patiala, Punjab, India[1,2,3]

Abstract

Medical Image Processing Modern three-dimensional (3-D) medical imaging offers the potential and promise for major advances in science and medicine as higher fidelity images are produced. Due to advances in computer aided diagnosis and continuous progress in the field of computerized medical image visualization there is need to develop one of the most important fields within scientific imaging. Lung cancer are related to smoking (or secondhand smoke), or less often to exposure to radon or other environmental factors that's why this can be prevented. But still it is not yet clear if these cancers can be prevented or not. In this research work, approach of segmentation, feature extraction and CNN will be applied for locating, characterizing cancer portion. The proposed approach is implemented in MATLAB and results are analyzed in terms of accuracy, sensitivity and specificity.

Keywords: Lung cancer, CAD, Image processing, CNN, GLCM, Threshold Segmentation.

I. Introduction

The image processing is a technique which is used for the enhancement of unprocessed pictures or images captured from different cameras from different origins. With the help of image processing, the significant data can be retrieved efficiently. In the last few years, various methods have been evolved in image processing techniques for the extraction of complicated information in an effective manner. The image processing technology is utilized by several operations in the last few years. This approach is widely utilized in army, clinical and investigational areas. Some associations also use image processing approach for simplifying the manual workload and execution of positive actions. The image processing is applied inside numerous applications inclusively in order to improve the optical description of pictures. For the preparation of pictures, different calculations are implemented as well. The other name given to the image processing is digital image processing. The digital image processing comprises both visual and analog image processing. The digital image processing involves different methods. Image acquisition is the other name given to the imaging. The visual and digital image processing can be performed with the help of imaging. This technique utilizes several domains like computer graphics for the generation of pictures. This technique also provides assistance in the manipulation and modification of pictures. The picture or image is analyzed with the help of processor hallucination or computer vision [1]. A picture involves some definite amount of sub-images and these sub-images are identified as region-of-interest. In order to provide a base for some definite region, different elements of a picture are congregated. The application of exacting image processing procedure is achievable inside image processing scheme by the assortment of suitable region. The shade version of a picture can be modified by the processing of definite picture section. Some other element of picture can be utilized for the suppression of movement haze. For image processing, the image should be present in digital format. A separate network inside the preliminary phase of digitization is used for the sampling of a picture. The fixed amounts of bits are utilized for performing the quantization of every pattern or image pixel. The processor relied digital operations are used for the implementation of image processing. The picture is converted from analog format to digital format for making the picture visible via scanning procedure.In lung cancer, anomalous cells multiply and grow in the form of a tumor. The lymph fluid which environs lung tissue carries the cancerous cells from lungs to blood. The lymph streams via lymphatic vessels. These lymph fluid drains into lymph nodules deployed in the lungs and in the middle region of chest area. The growth of lung tumor always carried out towards the middle area of chest due to the regular flow of lymph fluid towards the chest center. When a cancer cell leaves its origin area, metastasis happens. This cancerous cell now goes towards a lymph nodule or to different body part with the help of blood flow

II. Literature Review

Janee Alam, et.al (2018) proposed a novel algorithm for the detection and prediction of the lung cancer. The proposed algorithm provided very satisfactory results as compared to other existing algorithms [2]. The support vector machine algorithm was used for the classification of a suite of textural features retrieved from the alienated ROIs. The information about the presence of cancer cell within the input image contained could be identified by the algorithm. Wasudeo Rahane, et.al (2018) stated the seriousness of lungs cancer. In lung cancer, in the tissues of the lungs, the cancer cells increased unlimitedly [3]. The timely recognition of lung cancer was very important to save various people. The lung cancer was described in the projected system. This system also described its phases by means of different image processing and machine learning algorithms like, grayscale alteration, noise lessening and binarization. Ruchita Tekade, et.al (2018) used lung patient Computer Tomography (CT) scan images for the detection and classification of lung nodules and to identify the growth rate of that nodes. With the help of U-Net design, the CT scan images were segmented [34]. In this work, 3D multipath VGG-like network was proposed. The proposed network was assessed on 3D cubes. These three dimensional cubes were retrieved from lung image database Consortium and image database resource initiative (LIDC-IDRI), Lung Nodule Analysis 2016 (LUNA16) and Kaggle Data Science Bowl 2017 datasets. Lingling Li, et.al (2018) stated that earlier detection of lung cancer was possible from CT images. These images were obtained using image processing technologies and artificial intelligent algorithms [5]. Initially, the preprocessing of CT images was done to eliminate noise in the proposed system. For this purpose, the median filter and the Wiener filter were used. In the second stage, the preprocessed images were transformed to binary images using Otsu thresholding method. Thirdly, GLCM was used to compute the body regions extracted from the binary images and features (contrast, correlation, energy and homogeneity). Lastly, in order to set up lung cancer recognition models, BPNN and SVM, collectively with features, were employed. the BPNN model and SVM model showed accuracy level of 83.07% and 96.32% correspondingly for lung cancer recognition on the forecast set (451 images) as per the results. R. Janudhivya, et.al (2017) proposed Computer Aided Diagnosis system (CAD) to detect the pleural effusion and pneumothorax [6]. This affected the pleural membranes of the lungs. At first, the preprocessing of chest CT slices was done for removing the Gaussian noise with the help of a sigma filter. The employed segmentation method extracted the lungs and the areas influenced by pleural effusion. For this purpose, traditional thresholding methods such as Otsu's and iterative thresholding followed by morphological operations were employed. Afterward, Mumford shah model was implemented for the segmentation of lung parenchyma and for the extraction of the Region of Interest (ROI). Further, Spectral texture extraction method was used to extract texture features from the ROIs. K. Ravindranath, et.al (2017) stated that timely recognition of lung cancer included discovery of unsure nodules and classified them into dissimilar state of ailment [7]. The pattern matching and verification were included in the detection stage for increasing accuracy. This was performed using fuzzy logic, support vector machine, statistical classification models. The corresponding features such as texture, shape and density of the identified nodules were involved in the categorization stage for characterizing the regular cells (texture, shape and density) of nodules with acknowledged state of disease (confirmed by sample extraction techniques). Snehal Dabade, et.al (2017) stated that lung cancer was a dangerous lung tumor. This tumor was typified by the proscribed cell increase in tissues of the lung [8]. Lung cancer was the most frequent cancer identified internationally. More fatalities occurred due to lung cancer as compared to any other sort of cancer. The timely discovery and healing was extremely useful and effectual for the endurance of cancer patient. Different image processing and soft computing techniques could be employed to determine the cancer cells from medical images. Pooja R. Katre, et.al (2017) stated that cancer was a global disease. Lung cancer was mostly diagnosed in males and females from a number of cancer diseases [9]. The casualty rate due to the lung cancer could be decreased merely by the identification of this disease in early stages. In numerous medicinal fields, the image processing techniques were extensively utilized to enhance image for the timely discovery and healing phases. In the detection of lung cancer, the time factor was extremely significant for the detection of abnormal issues in destined images. The processing of CT image was done and the area of interest called cancer was recognized using the high boost filter. The high boost filter and watershed segmentation gave high quality results for the pre-processing phase. Three features such as area, perimeter, and eccentricity were extracted from the area. For identifying the size of the tumor and from the tumor size the cancer stage was recognized using these

features. Qing Wu, et.al (2017) proposed an EDM machine learning algorithm. The proposed algorithm was provided with vectorized histogram features [10]. The main aim of proposed algorithm was to identify SCLC for timely malevolent tumor forecasting. The proposed algorithm sensibly showed good forecasting correctness. However, there was the large scope of enhancement before the proposed algorithm in the medical field. S. Kalaivani, et.al (2017) proposed a novel algorithm for the detection of lung cancer in early stages. In this work, an automatic lung cancer detection system was proposed to detect the lung cancer at early stages [11]. The main aim of this approach was to minimize human error and make the cancer detection procedure more precise and comfortable.

III. RESEARCH METHODOLOGY

This research work is related to lung cancer detection from the CT scan image using image processing techniques. The proposed methodology has the four phases for the lung cancer localization and characterization. Following are the various phases of the lung cancer detection:-

1. Pre-processing:- The pre-processing is the first phase in which CT scan image is taken as input. The technique of image de-noising will be applied which will remove noise from the input image.

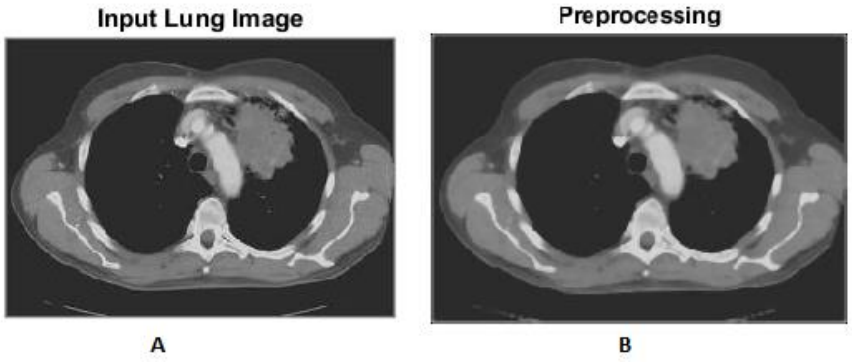

Figure.1 Preprocessing of Chest CT scan image.

2. Segmentation:- In the second phase, the approach of region based segmentation will be applied which will segment the similar and dissimilar regions from the CT scan image The outh's segmentation technique is applied for the segmentation. The sectioned picture attained from thresholding comprises several benefits like lesser storage space, speedy dispensation velocity and easiness in exploitation in comparison with gray level picture that generally includes 256 steps. In the presented work, a gray scale picture is utilized for thresholding process. In this process, rgb picture is converted into binary picture. The obtained picture is in the form of black and white.

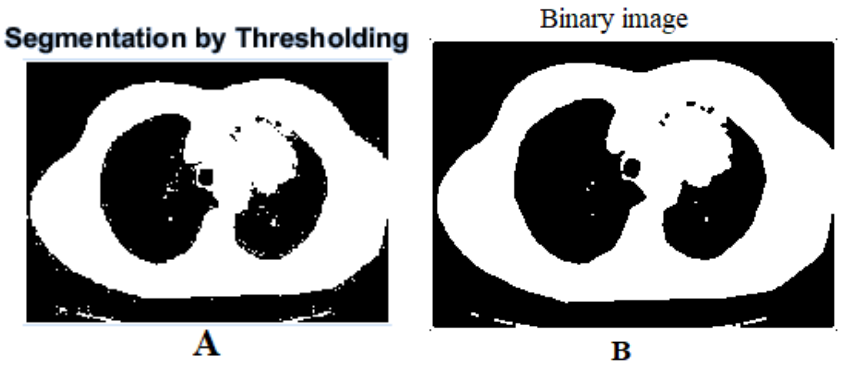

Figure.2 Segmentation and Binary image of Chest CT scan image

3. Feature Extraction:- The feature extraction is the third phase, in which GLCM algorithm will be applied for the feature extraction of the CT scan image In this step, the GLCM algorithm is applied for the feature extraction. The GLCM algorithm will extract the textural features of the input image. The GLCM algorithm extracts 13 features of the image for the tumor detection

4. Classification:- In the last phase, the approach of CNN will be applied which can categorize and localize the cancer part.All the data points of an individual class are separated by the best hyperplane, this can be identified through the classification provided by CNN. In the CNN the largest the best hyperplane is described by the largest margin between the two classes. There are no interior data points when there is maximum width between the slabs parallel to the hyperplane which is also known as margin. The maximum margin in hyperplane is separated by the CNN algorithm.

IV. Results and Discussion

The proposed approach is implemented in MATLAB. The proposed algorithm use the computer vision and neural network tool box to implementation. The results are analyzed in terms of sensitivity, specificity and accuracy.

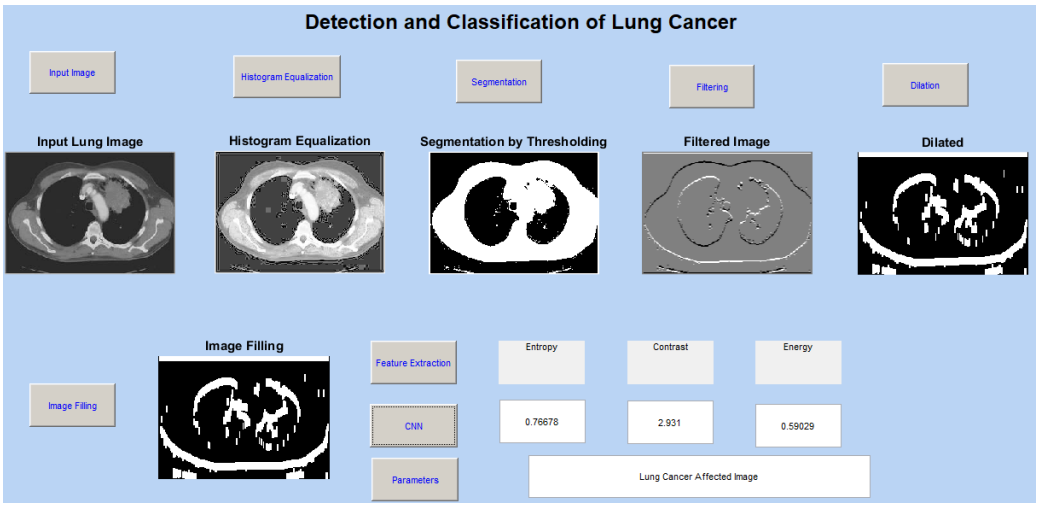

Figure.3 Interface of Lung cancer detection

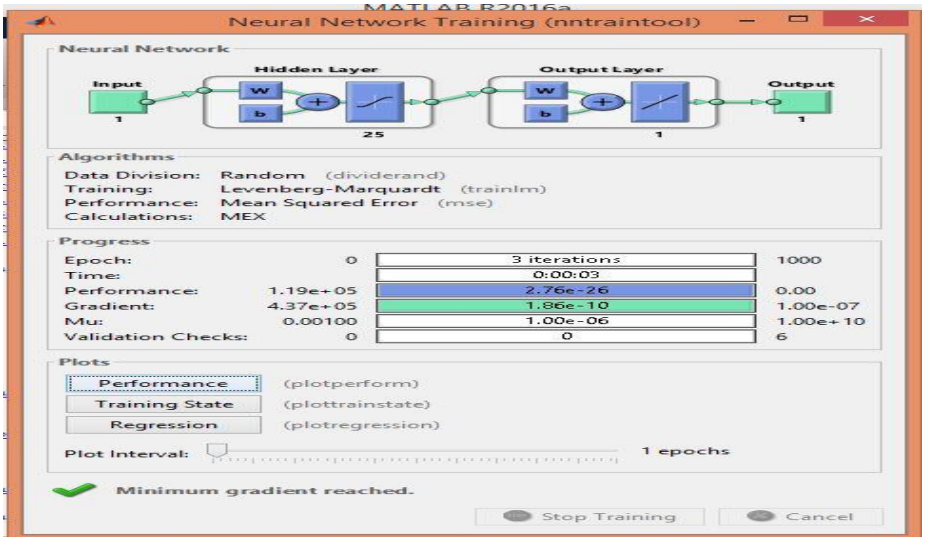

Figure.4 Neural network training

The proposed approach is implemented in MATLAB. The proposed algorithm uses the computer vision and neural network tool box for implementation. The interface of lung cancer detection is shown in the figure 3. In

the figure, all the techniques performed and tumor portion marked image is illustrated .As the CNN approach is applied for the tumor detection. The system will be trained to generate the desired results. The training of the neural network system is shown in the above given figure 4. Finally the system gives the parameters in the terms of sensitivity, specificity, and accuracy which are discussed below.

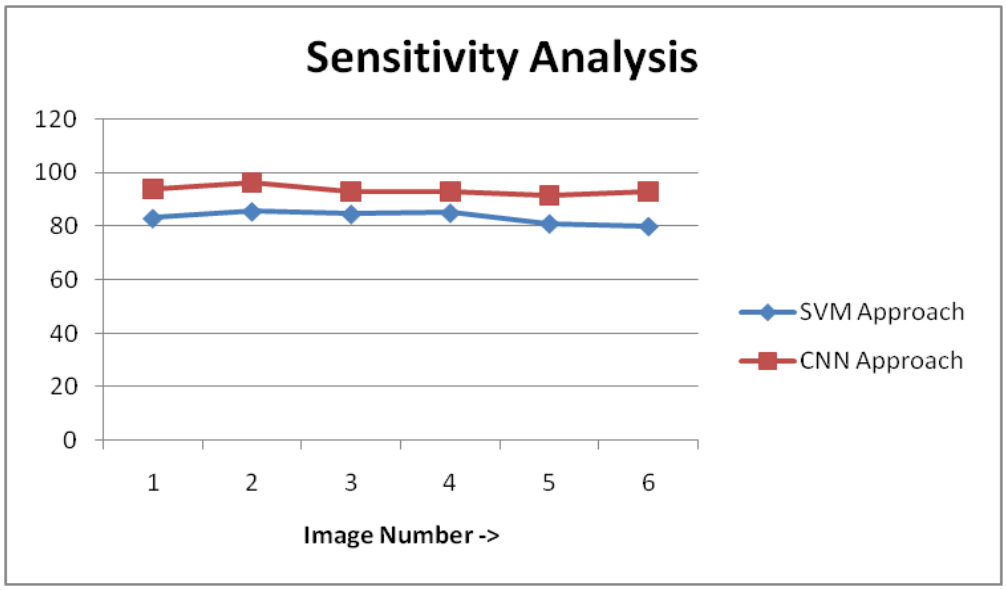

Figure.5 Graph for sensitivity Analysis

Table 1: Sensitivity Analysis

Image Number	SVM Approach	CNN Approach
1	81	92
2	83.5	94.5
3	84.52	93
4	85	93
5	81	90.5
6	81	93

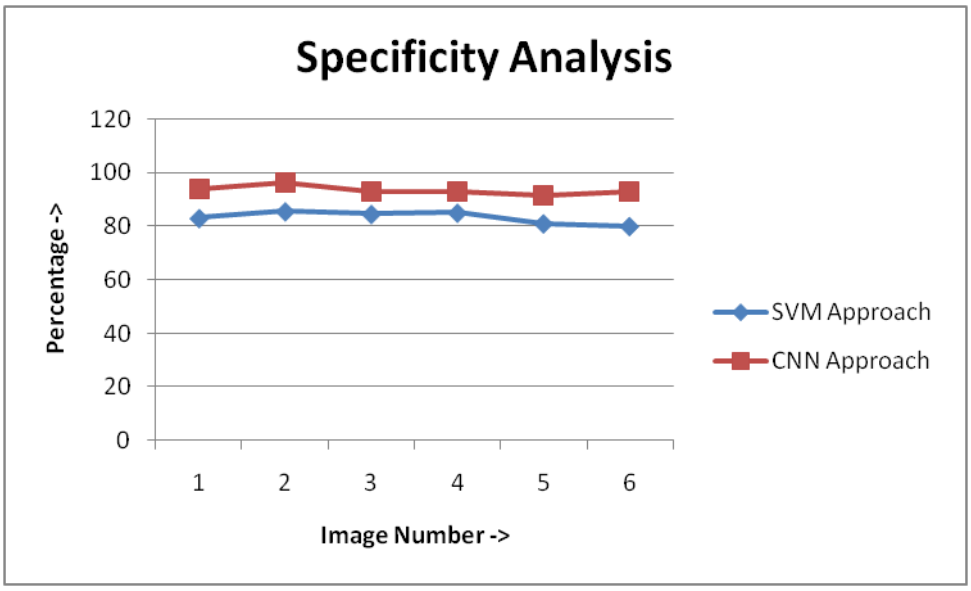

Figure.6 Graph for specificity Analysis

Table 2: Specificity analysis

Image Number	SVM Approach	CNN Approach
1	81	85
2	83.5	100
3	84.52	105
4	85	99
5	81	97
6	81	93

Table 3: Accuracy analysis

Image Number	SVM Approach	CNN Approach
1	80	93.5
2	84.56	99
3	89.52	90
4	84.5	90
5	80.6	93
6	81	97

The system achieved better results by the CNN approach when compared to SVM approach in the terms of accuracy, sensitivity and specificity. Thus the overall performance of the system was good in all the terms of parameters.

Conclusion

For lung cancer detection image processing is used. There are three steps for the detection of cancer nodule. To detect the presence of cancer nodule CT scan images are used. Further the pre-processing composed of two processes. Image enhancement and image segmentation are that two processes. For human viewer interpretability of information in the image is improved by image enhancing step. There are many enhancement algorithms such as Gabor filter, fast fourier transform, log gabor filter and auto enhancement. In pre-processing second step is Image segmentation. The purpose of image segmentation is to partition the image into meaningful region and to identify the object or relevant information from the digital image. The output from the segmentation process is goes to feature extraction stage. Features such as area, perimeter and irregularity are found out in feature extraction. On the basis of the extracted features the abnormality in lung are found out by the cancer cell identification module. The approach of GLCM and CNN will be used in this research work for localizing and characterizing cancer portion from the CT scan image. The proposed approach is implemented in MATLAB and results are analyzed in terms of accuracy, sensitivity and specificity. It is analyzed that with the proposed approach results are optimized upto 8 percent.

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