DETECTION AND CLASSIFICATION OF LUNG CANCER USING IMAGE PROCESSING TECHNIQUES

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***Abstract*— This paper presents the detection of lung caner by using various image processing techniques. Generally, cancer is the aberrant growth of cells. Lung cancer is the most dangerous disease-causing human death. It is caused by cancerous cells which replicates through out the lung. So, early detection of the disease is vital in terms of prevention. To accomplish this, researches have used image processing techniques. The most common technique is carried out by processing the Computer Tomography (CT) images. The four stages that has been discussed in this document are: image pre-processing, image segmentation and image classification.**

***Keywords*— Lung Cancer detection, Image process techniques, CT images, MATLAB**

I. INTRODUCTION

Lung cancer is the aberrant growth of cells. Lung cancer causes more deaths than any cancer. It is the most common cause of death globally accounting for 3% of annual mortality. Heavy smokers (25cigs/day) have a risk that is 20 times greater than that of non-smokers. 5% of cancer deaths are due to passive smoking. The main predisposing factors for this disease are smoking, asbestos exposure, occupational hazards, air pollution, familial predisposition, vitamin deficiencies. This disease is presented mainly with cough, blood in sputum, difficulty in breathing, pneumonia and wheezing.

Imaging studies play an important role in diagnosing the tumour.

1. Chest X-ray- it shows the changes occurred in the lung due to tumour such as any enlargement, peripheral opacities, collapse of the lung, erosion of the ribs.

2. Bronchoscopy- this is the direct visualisation of the bronchi. It is also helpful in taking biopsies in cases of suspicion.

3. Isotope bone scan, Computed tomography, mediastinoscopy and Ultrasound abdomen is done to find any metastasis to other organs.

Lung cancer is created by rampant growth of abnormal cells. Lung cancer are categorized into four groups: Juxta-vascular, Well circumscribed, Pleural tail and Juxta pleural [10]. With respect to stages, there are 4 stages of lung cancer: I to IV. Arrangement depends on tumour site and tumour lymph node location [6]. We know that, when cases are diagnosed early patients have higher chance of survival. But over 80% of lung cancers are not caught early. Randomised control trails have shown screening with CT's can reduce mortality. The figure 1 shown below shows the graph of survival rate at Stage I and Stage IV of cancer.

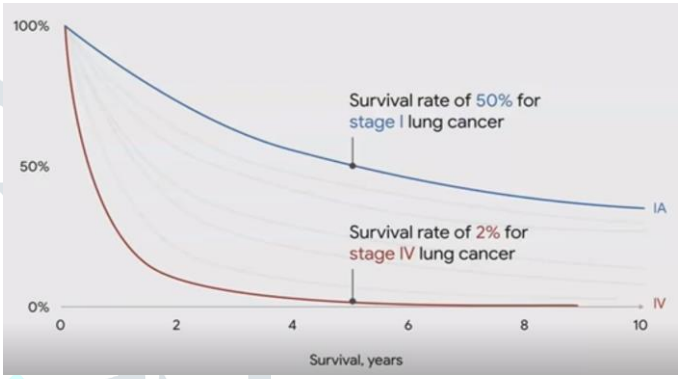

Fig 1: Graph of survival rate

II. LITERATURE SURVEY

Sajid A. Khan, Muhammad Nazir, et al "Lungs nodule detection framework from computed tomography images using support vector machine" in the year 2019[1]. This paper proposes the lung cancer detection based on edge and textural features. The system uses discrete cosine transform (DCT) and the classification using SVM. The results obtained are 98.64% specificity, 92.20% sensitivity, and 97.62% accuracy.

Ayushi Shukla, Chinmay Parab, et al "Lung Cancer Detection using Image Processing Techniques" in the year 2018[2]. Tophat filtering is done for the image pre-processing. Image segmentation uses thresholding, edge detection and watershed. The various feature parameters used are area, perimeter and eccentricity. Grey-Level Co-Occurrence Matrix GLCM examines the texture feature. Classification uses SVM approach.

Apoorva Mahale, Chetan Rawool, et al "A Survey on Lung Cancer Detection using Image Data Analysis and Machine Learning" in the year 2017[3]. In this paper, segmentation is carried out by using Modified Fuzzy Possibilistic C-Means. Feature extraction plays a vital role in the classification of the disease.

Suren Makaju, P.W.C. Prasad, et al "Lung Cancer Detection using CT Scan Images" in the year 2017[4]. In this paper, image pre-processing uses Median filter followed by Gaussian filer. Watershed segmentation is implemented. SVM is the classifier that is been used. 92% of accuracy is reached. Node classification is 86.6%.

S.Shyamala, Dr. M. Pushpa rani "Image processing techniques for Lung Cancer Detection" in the year 2016[5].In this paper, Image enhancement uses Gabor filter, auto enhancement and FFT. Image segmentation uses thresholding. Feature extraction uses binarization approach.

Damodar Dipika A, Prof. Krunal Panchal "A Survey of Lung Tumour Detection on CT Images" in the year 2015[6].

Comparative analysis on classifiers like: Bayes classification and active contour modeling, Random walks algorithm and ROI, Click and grow algorithm, Self-organizing maps method and ANN, Neural networks, ROI, neural fuzzy classifier and Random walks algorithm.

C.Bhuvaneswari, P.Aruna, D.Loganathan "Classification of Lung Diseases by Image Processing Techniques Using Computed Tomography Images" in the year 2014[7]. Image enhancement uses Gabor filter, auto enhancement and FFT. Image segmentation uses thresholding and watershed method. Results obtained for feature extraction is used for classification.

Mr.Vijay A.Gajdhane, Prof. Deshpande L.M. "Detection of Lung Cancer Stages on CT scan Images by Using Various Image Processing Techniques" in the year 2014[8]. The new techniques used are: smoothing, enhancement and gaussian radial basis function.

Vipin Kumar Jain, Dr. Ritu Vijay "Lungs Cancer Detection from MRI Image Using Image Processing Technique" in the year 2013[9]. MRI images of the lung are taken with various angles. Suspected image is chosen. Comparison between the image sample of suspect part of image and normal side of image is done.

Anita Chaudhary, Sonit Sukhraj Singh "Lung Cancer Detection on CT Images by Using Image Processing" in the year 2012[10]. In this paper, it uses median filter to remove salt and pepper noises. For the featured extraction Genetic algorithm is been used. For classification, Naïve Bayes and J48 decision tree classifiers are used which are machine-learning algorithms.

Mokhled S. AL-TARAWNEH "Lung Cancer Detection Using Image Processing Techniques" in the year 2012[11]. The results from this paper are: Gabor filter gives 38% of enhancement percentage. Fast Fourier transform gives 27%. Thresholding segmentation about 81% and Watershed is 85%. Binarization approach of classification is 92% and masking approach is 85%.

Samuel G. Armato III, Maryellen L. Giger, et al "Automated detection of lung nodules in CT scans: Preliminary results" in the year 2001[12]. The process carried out is: 2D processing, 3D analysis and feature extraction. Nodule detection performance is 70%, nodule sensitivity of 89%.

III. PROPOSED METHODOLOGY

The proposed methodology that is been used here are: Pre-processing, feature extraction and classification. The software used for processing is MATLAB.

A. Image pre-processing

The images which is been captured as CT images from the datasets are Image capture. These images are taken into the next stage i.e. Image pre-processing. In this stage, the main aim is to enhance the quality of the image and providing them as better input to automated processing techniques.

i) Image Enhancement

The first stage in Image pre-processing, Image Enhancement is used to obtain much clearer and quality images. Some of the techniques been used are: Gabor filter, Fast Fourier transform and auto-enhancement techniques [11]. The next step is the segmentation of the image.

B. Image Segmentation

Image segmentation algorithm plays an effective rule image processing stage. In this stage, digital image is partitioned into multiple segments. Image segments is being viewed in as pixels or super pixels. The two segmentation techniques are: thresholding and watershed [11].

Watershed segmentation method segregates and shows the specified objects. The output image obtained implies that light pixels match high elevations and dark pixels with low elevations [10].

Thresholding trims the grey image to binary image. It is the most powerful tools for image segmentation [2].

Binarization: In the process, the segregation is done based on colouring, such as black and white. Binarization process is carried out based on threshold [11].

C. Classification

The final stage is the classification of lung nodule for the CT scanned lung image. We classify the condition of lung based on the threshold value. The threshold value is obtained from the observation of a normal lung. The value is 17178.84 [11].

IV. RESULTS

The results of lung cancer detection and classification are shown in the MATLAB software.

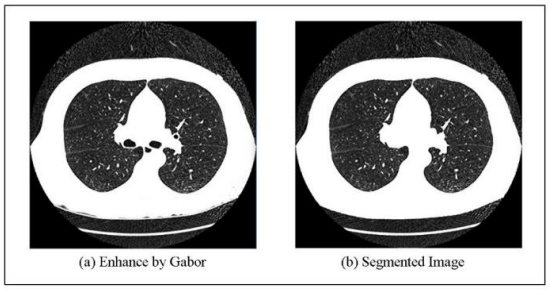

Figure 2: Segmentation by watershed method

Figure 2a indicates the enhancement by the Gabor filter method. Figure 2b is the next stage, segmentation of the enhanced image by watershed method.

Binarization for image classification results are shown in the table 1 below.

Table 1: Detection result of sample patients

Patient	Black pixels	Result
1	67042	Non-Cancerous Lung
2	24858	Non-Cancerous Lung
3	19571	Non-Cancerous Lung
4	15018	Cancerous Lung
5	10589	Cancerous Lung
6	9987	Cancerous Lung

The datasets used are extracted from the database of JSRT (Japanese Society of Radiological Technology) which is publicly available. Table 2 shows the accuracy of the proposed methodology. A total number of 120 CT scanned images in dcm format.

Table 2: Confusion matrix for the proposed methodology

True positive (TP) = 75%	False positive (FP) = 8.33%
False negative (FN) = 4.16%	True negative (TN) = 12.5%

$$\text{Accuracy} = \frac{TN + TP}{FN + FP + TN + TP}$$

Therefore, accuracy calculated for the proposed system is 87.5%.

V. CONCLUSION

The issues encountered in lung cancer detection has been dealt with in this paper. Lung CT images has been used over here as input datasets. In the first stage, the enhancement of the image is been carries out from the extracted CT images. The next step is segmentation of the enhanced image. Watershed method is been used for the Image segmentation because of the higher accuracy than any other method. This image formed is sent to the binarization classification which classifies based on the black pixel on comparison with the threshold value. Thus, this methodology gives the early detection of the lung cancer to the patient. The future enhancement to this project is implementing deep learning using Neural Networks for better detection and classification of Lung cancer disease.

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