A FEASIBILITY STUDY OF LUNG CANCER DIAGNOSIS BY HIGH INTENSITY PIXELS IN LUNG CT IMAGES

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ABSTRACT: According to world health organization the most common cancer is the lung cancer considering 1.7 million deaths and two million new cases in 2018.It is the biggest cancer killer in both women and men worldwide. If lung cancer is detected and treated before it metastasizes the chance for a cure would be excellent. The imaging techniques used for detection are chest radiography, computed tomography(CT),MRI and PET. The CAD system is the one which helps the physician for detection of the disease and also gives a second opinion to make the final decision. Here in this study, a method is proposed for computer aided diagnosis (CAD) of lung cancer to study the feasibility of using the number of pixels with high intensity present in the lung CT images . For experimentation total 14 images of cancerous and healthy lungs were taken and the results obtained showed an accuracy of 78%.
Keywords: Lung Cancer, Computer aided diagnosis, High intensity pixels, Lung CT images
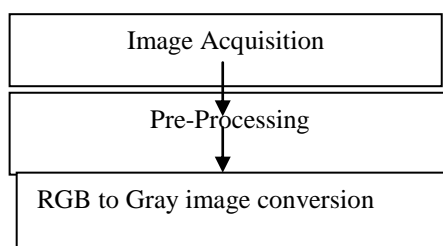
1. Introduction

Lung cancer a primary lung cancer incorrectly known as bronchogenic carcinoma.It is a term which refers to the histological subtypes of primary lung malignancies that are related with inhale carcinogens smoking cigarette being main cause for it: symptoms are coughing up blood, loosing weight, bone pain,headache,shortness of breath. Computer aided diagnosis(CAD),it is an assisting tool for a clinician to make a diagnosis.It have been use extensively within radiology for many years.The applications are for detection of breast cancer on mammography and detection of pulmonary nodules on chest CT.It is used broadly for both computer aided diagnosis and computer aided detection:Computer aided diagnosis(CADe) marks specific areas of images that may seen abnormal designed to reduce the risk of missing pathologies of interest.Computer aided diagnostic(CADx) helps a practitioner asses and classify pathology in medical images.Henschke et al[2],presented that lung cancer in an

early stage shows itself as apulmonary nodule.Chest CT scan in a thin slice helical have a sub-millimeter resolution at which pulmonary nodules can be detected.Kim et al[3],published a paper on computerized detection of sub-solid nodules relate a slice-based computer aided diagnosis systems using intensity features and texture analysis.Anita chaudhary et al[4] proposed a method using MATLAB have been used.The various techniques used are preprocessing, segmentation and feature extraction have been converse to get more accurate results. Sruthi ignatious et al[5] proposed a method to identify a lung cancer detection systems that will detect tumor accurately. the techniques will cause accurate predictions of cancer.Jue jiang et al[6] suggest a method that combine the features of resolutions using multiple images and feature levels to detect the segment of lung tumor and developed a multisclae for volumetrically segmenting lung tumors with an approach of CNN, the measurement of tumor volumes in lung and identification of lung tumor.Jhilam Mukherjee et al[7] suggested a method that detects from lung CT images   and classify SPN (solitary pulmonary nodules) which is responsible for lung cancer .The results obtained from experimentation are in respect to classification of nodules with respect to malignant and begign.Based on geometric features of lung nodules a method for automated detection of nodules has been classified as malignancy and benignity depending upon their shape parameters like circularity,diameter,ratio etc.Rachid sammouda et al[8] proposed a method on to segment extracted lung regions from CT lung images using ANN classifier .The pixel which are used to magnify the edges for detection of lung region lobes.Twinkal Patel et al[9],suggested a feature extraction technique for identifying for diagnosis of lung cancer which is based on the shape of the histogram of local energy pattern this will lead a process that will give a better results for all kind of dataset.

2. Methodology

From the proposed method as shown in figure1. A set of 14 images are taken which 5 images are of normal lung ct images and 9 images are of lung cancer .The acquired images are converted to gray which are then filtered using median filter and enhanced by contrast stretching method.

The lung is then segmented by thresolding technique; Segmented Lung image is first divided into left lung and right lung;. Pixel intensity level 150 is used to find out higher intensity pixels. Using these values of higher intensity pixels a reference value is calculated
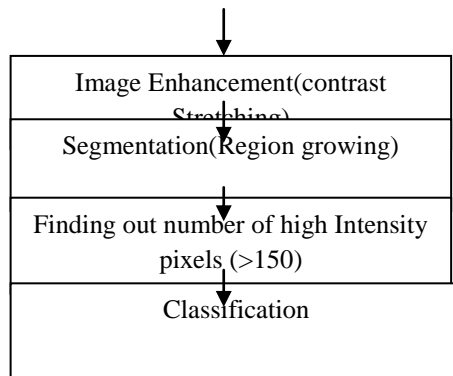
Image Acquisition

Pre-Processing

RGB to Gray image conversion

Image Enhancement(contrast Stretching)
Segmentation(Region growing)
Finding out number of high Intensity pixels (>150)
Classification

Figure1:Flow diagram of proposed method

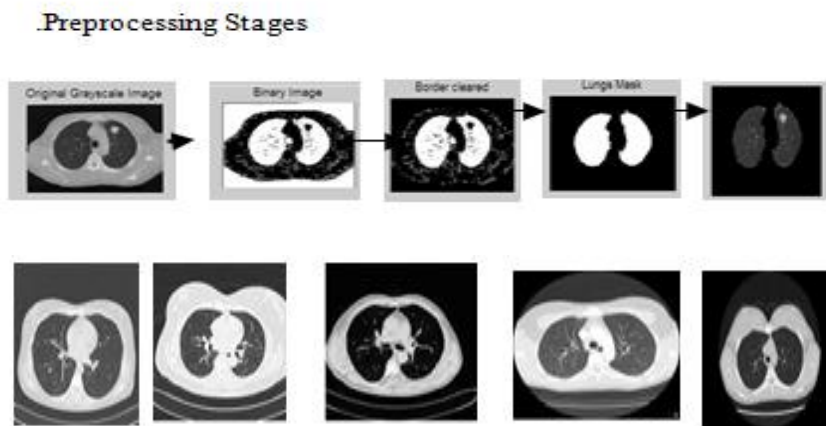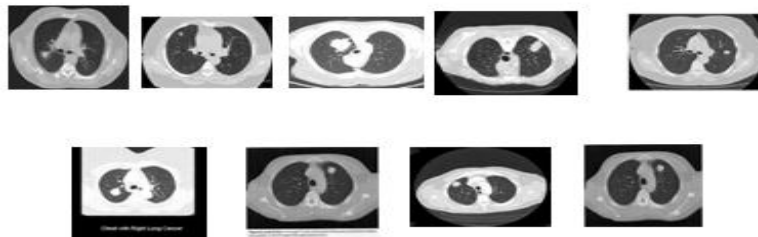.Preprocessing Stages

Figure 2: Normal Images

Figure 3: Cancer Images

Table 1. Number of pixels >150 (high intensity level) in healthy lung images

Sl. No	Right lung	Left lung	Difference (X_{HL})	$(x_{HL}-XHL)$	$(x_{HL}-XHL)^2$
1	17	22	5	39	1521
2	124	174	50	6	36
3	72	129	57	13	169

4	73	108	37	7	49
5	141	210	69	25	625
	Av(X_{HL})= X_{HL}=44				

Av(XHL)=Average of number of pixels with high intensity level of healthy lung images

Calculation: Av($P_{HL)}$ =480

Where Av(P_{HL}) is the avearage of $(x - \bar{X})^2$

$(P_{HL)} = \sqrt{\dfrac{\mathbf{\Sigma}(x - \square x)^2}{n}} = \sqrt{\dfrac{2457}{5}} = \sqrt{480} = 22$

where $\sigma(P_{HL})$ is the standard deviation of number of pixels with high intensity level present in healthy lung images.

(PHL)= 22

Table 2. Number of pixels >150(high intensity level)in cancerous lung images

Sl. No	Right Lung	Left lung	Difference	$(x-\square X)$	$(x-\square X)^2$
1	7	146	139	203-139 =-64	4,096
2	120	11	109	109-203=94	8836
3	36	23	13	203-13=190	36100
4	165	106	59	203-59=144	20736
5	29	42	13	203-13=190	36100
6	126	18	108	203-108=95	9025
7	116	1262	1146	2031146=57	88924
8	36	175	139	203-139=64	4096
9	59	168	109	203-109=94	8836
	Av(X_{CL})= X_{CL}=203				

Av(XCL)= Average of number of pixels with high intensity level of cancerous lung images

Calculation:

Av(PCL)=2408

Where Av(PCL) is the avearage of $(x-\square X)^2$

$$\square(P_{CL)} = \frac{\sqrt{\mathbf{\Sigma}(x-\square x)^2}}{n} = \frac{\sqrt{216749}}{9}$$

where $\square(P_{CL})$ is the standard deviation of number of pixels with high intensity level present in cancerous lung images.

(PCL)=$\sqrt{24083}$=203

4. Discussion

A set of 14 images is taken of which 5 images are of normal lung ct images and 9 images are of lung cancer .The acquired images are converted to gray which are then filtered using median filter and enhanced by contrast stretching method. The lung is then segmented by thresholding technique; Segmented Lung image is first divided into left lung and right lung.

The number of pixels with high intensity level >150 that are present in the left and right lung images are found out ;these are termed as higher intensity pixels. From table 1 and 2, it is seen that the difference in the number of pixels with high intensity level present in the left and right lobes of healthy lung images is not very pronounced as in the case of cancerous lung images. Since cancerous nodules look bright in the image and the pixels which are responsible for this brightness only constitute the nodule and they lie close. Hence the number of higher intensity pixels present in the cancer affected lung portion will be more compared to that of healthy lung images. since its very unlikely that the left and right portion of a lung is affected by cancerous growth simultaneously, the difference in the number of higher intensity present in left and right portions the cancer affected lung is much higher compared to that a healthy lung.Using the number of pixels with high intensity level the threshold value is calculated as

Threshold calculation:

Threshold Fixing :

Threshold T1=Number of higher intensity pixels which is taken as threshold to classify as healthy and cancerous lung images is found as follows:

$$T1 = \frac{\text{Mean difference of healthy lung images Mean difference of Cancerous lung images}}{2}$$

$$T1 = \frac{Av(\text{XHL})+ Av(\text{XCL})}{2}$$

$$T_1 = \frac{44+203}{2} = 123.5 \sim 124$$

Decision Rule 1:

124 is taken as threshold and the decision rule is framed and if the difference between the number of higher intensity pixels is present in left and right lung images is greater than 124 the images is suspected to be cancerous, If it is lesser than that it is taken as healthy image.

i.e number of higher intensity pixels N(P150)>124 the image is cancerous

i.e number of higher intensity pixels N(P150)<124 the healthy image.

The accuracy in this decision rule is found to be 57%.Out of 14 lung images 5 are healthy images and 3 of the cancerous are rightly identified where as 6 of the cancerous images are wrongly identified as healthy images, this leads to 42% of false positive.

To increase the accuracy the decision rule is changed with a new threshold value which is found using the standard deviation values along with average values of higher intensity pixels as described below,

Accuracy Analysis

The standard deviation σ is found for healthy σ(PHL) Cancerous σ(PCL)

lung images and these values are found to be equal to 22&155 respectively,

Thresold T2: The T2 is the number of pixels with high intensity level which is found as ,

$$T2 = \frac{[XPHL+ \sigma(PHL)]+[XPCL- \sigma(PCL)]}{2}$$

$$T2 = \frac{[44+22]+[203-155]}{2}$$

$$T2 = \frac{66+48}{2}$$

$$T2= 57$$

Decision Rule 2:

If Number of pixels with high intensity level N(P150)>57,it is cancerous lung images

If it is lesser than N(P150)<57 it is termed as healthy lung.

Accuracy Analysis:

 ➢ Total number of images =14

 ➢ Number of healthy images =5

 ➢ Number of cancerous images =9

Out of 5 healthy lung images ,1 fails; and out of 9 cancerous lung images 2 fail,11 out of 14 images are rightly identified.Therefore the accuracy is equal 11/14=78%,The percentage of false positive =1/14=9% and true negative will be identified 2/14=14%. T2 is found to be sustainable as threshold and T2 is taken as the threshold and termed as T,decision rule 2 is taken as decision rule for classification of cancerous lung images.

5. Conclusion

A computer aided diagnosis for healthy and cancerous lung images using number of pixels with high intensity level having higher than 150 to screen for lung cancerous is proposed. Fourteen images were taken for experimentation and accuracy of method is found to be 78%,the true negative value (14%) are greater than the false positive (9%).The accuracy of the proposed method would to be improved, if the blood vessels in the image are removed before finding the number of pixels with high intensity level present in the image. The accuracy can be confirmed only after experimenting the method on a larger data set .

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