Lung Cancer Detection Using Image Processing Techniques: Review

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Lung Cancer Detection Using Image Processing Techniques: Review

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Abstract:
Today, Lung Cancer has become major threat in world. Thus, Cancer is the second most disease responsible disease for death. In view of these facts, this paper presents systemic review based on different types of processing techniques. These techniques have been divided into some fundamentals phases. The main intention of this paper is early lung cancer detection as it increases the chance of survival among people. This paper first discusses the pre-processing techniques and image segmentation techniques have been used. Paper also finds the feature extraction and classification of data sets used in papers from year 2011-2017.

Keywords: CT-Scan images: Enhancement; Feature Extraction; Segmentation Watershed Segmentation; Thresholding; Masking.

I. INTRODUCTION

Cancer is one of the most serious health problems in the world. Cancer is a large family of diseases that involve abnormal cell growth with the potential to spread to other parts of body. There are different types of cancer. Lung cancer is very common among them. Lung cancer found in both men and women in all over world. Hence Lung cancer is of two types: 1.SCLC (Small Cell Lung Cancer) and 2.NSCLC (Non-Small Cell Lung Cancer). SCLC include around 10-15% of lung cancers. It the most aggressive also is related to cigarette smoking. Whereas NSCLC include 85% cases of lung cancer and these types of cell are found in tumor.

Identifying of Lung cancer can be done through its symptoms include cough, coughing of blood, fatigue, unexplained weight loose, shortness of breath etc. Then to detect lung cancer first screening must be done through Chest Radiograph (X-RAY), Computed Tomography (CT) scan, Magnetic Resonance Imaging (MRI) scan images etc. The CT scan images are pre-processes remove the different Gaussian white noise using mean filter technique [4]. Lung cancer detection thus processed on three stages: Pre-processing, Segmentation, Post-processing. This paper focused on different techniques used in year 2011-2017 is summarized in table 1.1.

Year	Author	Techniques	Applications
2011	Disha Sharma & Gagandeep Jindal	Weiner Filter	System Identification, -Noise reduction, -Signal detection.
2012	Mokhled S.Al-Tarawneh	Gabor Filter	Optical character recognition.
2013	A.Asuntha,A.Brindha, & S.Indirani	Layer Separation	-Used to separate layer of image.
2014	Bhagyashri & Prof. Sanjeev N. Jain	Enhancement	-Used to sharpen the image.
2014	Mr.Vijay, A.Gajdhane & Prof.Deshpande	Gray scale Image	-Used to convert color in gray.
2015	Shahid Eqbal & Dr. M. A. Ansari	Noise reduction	-Used to reduce the noise of image.
2015	Sruthi Ignatious &Robin Joseph	Image Enhancement	-Use to emphasize and to reduce noise of image.
2015	Ajil M V & Sreeram S	Fast Fourier Transform	-Fast large integer -Polynomial multiplication.
2016	Santosh Singh, Yogesh Singh & Ritu Vijay	Enhancement	-Used to enhance image.
2016	Bhawana Malik & Jaykant Pratap Singh	Computer-aided design (CAD)	-Zoom in. -Layering.
2017	Kamil Dimiler, Buse Ugur, Yoneg K.Ever	Image Thresholding	-Convert gray scale image into binary image.

Table 1.1: Techniques used in Image processing from Year 2011-2017.

II. PRE-PROCESSING OF LUNG CANCER

Pre-processing is done before Image processing to remove errors, reduce noise and thus provide rectified image. Thus pre-processing involves various techniques as shown in figure 1.

a) **Image Enhancement:**

Image Enhancement is a technique to provide good perception of information of different images to viewers. Thus image enhancement can be classified in two different ways- one is spatial domain and another is frequency domain [2].The aim of image enhancement is to improve the interpretability of information included in the image for human viewers or to provide better input for other automated image processing techniques[6].

b) **Computer Aided Diagnosis:**

Computer aided system (CAD) takes the many different CT scan images of lung cancer patients of their chest as input and as an output gives the status of patients on basis of classifiers [4].

c) **Gabor Filter:**

Gabor filter was developed by Dennis Gabor. It is mainly used for 2D images e.g. CT scan images. Where Gabor filter has been find very useful and essential tool in processing of image used for analyzing of texture, color, etc. [3]. Image pre-processing based on Gabor function makes a local and multi-scale [6].Gabor filter is thus a liner filter which also has an impulse response. Impulse response is explained by multiplying a harmonic function with a Gaussian function. [8].

d) **Weiner Filter:**

The main aim of weiner filter is to filter noise that has conducted many signals. Weiner filter gave a statistical approach. Thus, weiner filters are explained by the following:

1. Assumption
2. Requirement
3. Performance criterion [5].

e) **Fast Fourier Transform:**

Fast Fourier Transform is a technique which operates on Fourier transform of any of the images. FFT is used in filtration of images [6].Thus FFT is very fast version of Discrete Fourier Transform. Also the theory of Fourier conveys that the operation is used to enhance the image in frequency domain [8].

f) **Layer Separation:**

Each Image is formed of many pixels. Where each pixel consists of RGB values. Also layer separation is mainly used to eliminate the effect of red and blue colors and also represent the image in green color [7].

g) **Gray Conversion:**

A Gray conversion is of level image that can be easily processed into the comparison of different colored images [7].

Table 1. 2: Techniques of pre-processing

Techniques	No. of Papers
Weiner Filter	1
Gabor Filter & Fast Fourier Transform	2
Layer Separation & Gray Conversion	2
Smoothing, Image Enhancement	5
Computer-Aided Detection	1

Many Techniques helps in pre-processing of image so to reduce noise and remove errors, and result is shown in table 1.2 shows. From year 2011-2017, Weiner Filter is only used 9% for signal detection, Gabor filter and Fast Fourier Transform is used 18% for optical character recognition and polynomial multiplication simultaneously. Smoothing Image Enhancement is mostly used for enhancing and for reducing noise of image and these techniques are used 46% in last 7 years. Whereas gray conversion and layer separation techniques are used 18% times from 2011-2017, result shown in Figure 1.

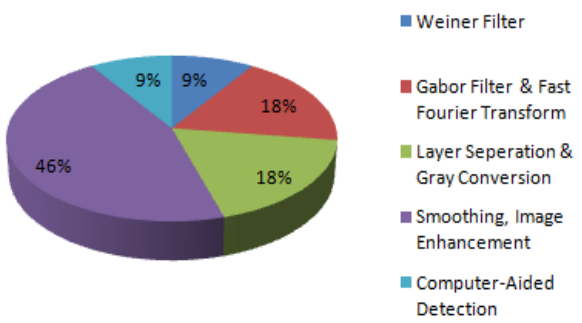

Figure 1: Proposed Techniques of Pre-Processing.

III. IMAGE SEGMENTATION

Image Segmentation is very useful and essential process for analyzing of images. Thus image segmentation converts or divides different images into different objects [2]. The word image segmentation means separation of medical images i.e. CT- scan, x-ray images etc from lung nodules [4].

The goal of Image segmentation is to solve or to perform the display of the image into something that is more useful and easy to detect. Image segmentation used to locate lines, curves, etc. in Images. The result of segmentation is a set of different segments that covers edge detection. All the pixels in a set are of color, intensity or texture [6].

The segmentation of image is done through following techniques:

- **Marker-Controlled Watershed:**

Marker-driven watershed segmentation is a technique that indicates presence of background at locations of images [6]. Marker-Controlled Watershed segmentation follows following steps:

Step 1: It read the color of image and then changes to gray scale image.

Step 2:Then, as function segmentation it also compute gradient magnitude.

Step 3: Within the image it mark the foreground objects.

Step 4: Within the image it find out the background marker points.

Step 5: It now find the watershed.

Step 6: Finally binary image result is obtained [1].

- **Thresholding Approach:**

Thresholding is very strong tool for segmentation of images. Thus Thresholding is also operation that's called non-linear which converts gray-scale image into different binary images [6].

Thus Thresholding approach is very helpful approach in changing different foreground from the different background.

The binary image should have all data of positions and shapes of foreground images. There is benefit of having binary images first is that they reduces complexity of information collected and solve the process of recognition and also classify them. Thus thresholding approach uses Otsu's method which gave satisfactory results for biomedical images [3].

- **Watershed Segmentation:**

The watershed is an algorithm mainly used in the unsupervised pattern for segment of images into different set of non-overlapping [3].

- **Morphological Operation:**

Morphology is a technique which is depends on shapes. Morphology operations are erosion, dilation, closing and opening and their function is to remove unnecessary parts [9].Where morphology opening is used to eliminate the small parts from inside and outside of lungs. Then morphology closing is applied to fills the gaps of borders and to enhance them [4].

Table 1.3: Techniques of Image Segmentation

Segmentation	No. of Papers
Marker-Controlled	5
Thresholding Approach	3
Watershed	1
Morphological	2
Weibull	1

For analyzing and segmentation of image, Different types of segments are used, result shown in table 1.3. Marker-Controlled Watershed segment is used highest time whereas Weibull is used very less as shown in Figure 2.

- **Weibull Segmentation:**

Weibull segmentation is used mainly for medical images. This segment displays the shape, texture, scale etc of medical images [8].

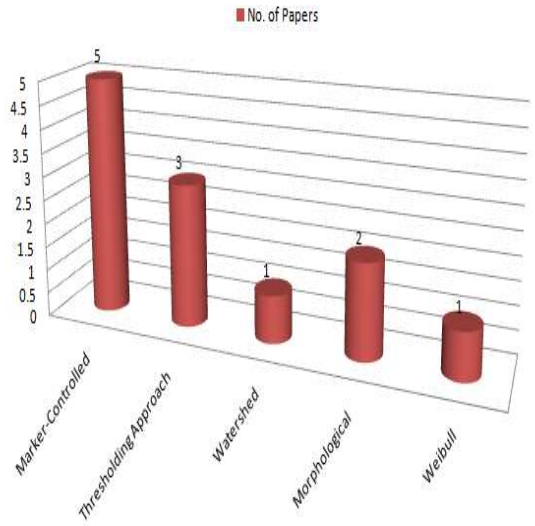

Figure 2: Proposed Segmentations.

IV. FEATURE EXTRACTION.

Lung cancer nodule has many numbers of features. It is also essential to extract features from it. The main goal of feature extraction is to define the shapes of cancer nodules. Basically there are two types of ways to extract features i.e. textural and Structural [4].For feature extraction basic characters are required which are measured in scalar [3]. These features are also used for detection and staging of lung cancer [1]. The features are explained below:

a) Area

Area contains the scalar values. It also gave actual number of nodule pixels overall in the extraction by ROI [14].

b) Perimeter:

Perimeter also obtains the scalar values. It's the summation of boundary or outline of interconnected cancer portion within the lung [1]

.

c) Eccentricity:

Eccentricity is to determine lung cancer or tumor roundness. Value of eccentricity is equal to 1 [1].

d) Convex Area:

Convex area is a small convex polygon which covers the tumor of cancer portion in the lung. Convex area is also a scalar value [1].

e) Mean Intensity:

It tells the average intensity of pixels [1].

Hence, two approaches used for feature extraction and to predict the probability of lung cancer. These approaches are:

- **Binarization approach**: This approach is based on that number of black pixels is greater than number of white pixels in normal lung images but if the number of black pixels is less than the threshold, then the image is not normal [3].
- **Masking approach:** This approach is based on that different masses looked like white linked areas in the ROI, because as they increase, the percent of cancer also increase. In masking approach, the presence of solid blue color shows the normal case but presence of RGB color shows the cancer presence [3].

Table 1.4: Techniques of Feature Extraction.

Techniques/Approaches	No of Papers
Area of Interest	4
Masking Approach	2
Eccentricity	4
Convex Area	1
Binarization Approach	2
Mean Intensity	1
Perimeter	4

Feature Extraction is very important for getting lung nodule to find shape or region where cancer is. Table 1.4 shows the different feature extraction approaches used in seven years and area of interest, eccentricity and perimeter are the best feature to find nodule or region of cancer shown in Figure 3.

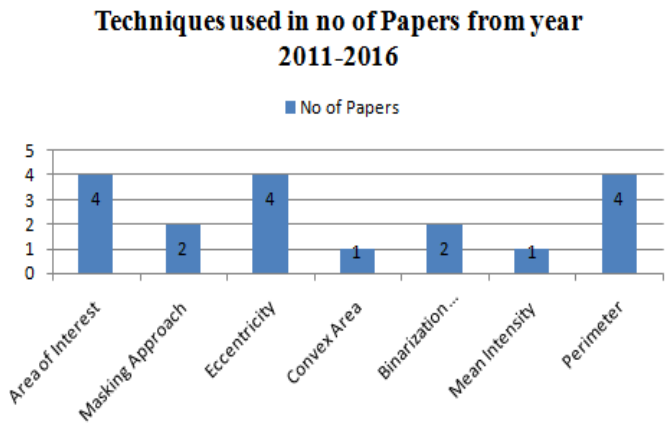

Figure 3: Proposed Techniques/approaches of Feature Extraction.

V. CLASSIFIACTION

After extraction of features from region of lung some algorithms are applied for classification of data into their regions. Those algorithms are only known as classifiers. There are two types of classification supervised and unsupervised classification [4].

Supervised classification: They give the known labels or correct outputs with vectors then these training are called supervised classification. For example they are: Support vector machine (SVM), K-Nearest Neighbors (K-NN), artificial neural network (ANN) etc.

Unsupervised classification: They categories the data automatically without use of class labels, then these are known as unsupervised learning. For example these are: K-mean clustering, Mixture models, Hierarchical clustering etc. But above all classifiers SVM give better result [4]. Support vector machines (SVM) are applied which are supervised learning models. SVM thus basically used to analysis data and recognize different patterns for different classification purpose [2]. SVM initializes by covering some set of input data and also predict for them, it also make it a non-probalistic binary linear classifier [7].

VI. CONCLUSION AND FUTURE SCOPE

An attempt is made to detect lung cancer using image processing techniques. Initially the CT scan image are captured and processed, their cancer or tumor region is identified correctly from the original image. Then in pre-processing stage many techniques are used for filtration to avoid the noise of images like: Weiner filter, Fast Fourier Transform etc shown in figure 1.1. After pre-processing Image segmentation is done through Marker-Controlled Watershed and Watershed Segmentation etc shown in figure 1.2. Then after segment of images features extraction is done by Area, Perimeter, Eccentricity etc shown in figure 1.3. They help to identify that lung cancer is of different stages and also tell different dimensions. Then classifiers are purposed. In classification Support vector machine and by random tree are used for staging of lung cancer and also used for early detection mostly from year 2011-2017.For Future work, we can implement Image Processing Techniques on X-ray images and MRI images for more accuracy. And for classification k-mean or fuzzy c-mean clustering can also be used. Moreover Comparison can also be done between X-ray and CT scan images for better result for lung cancer detection.

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