IMAGE ENHANCEMENT TO DETECT THE LUNG CANCER AT EARLY STAGE USING MEDIAN FILTER

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ABSTRACT

Lung cancer which is among the five main types of cancer is a leading one to overall cancer mortality. Cancer is a serious health problem among various kinds of diseases. World Health Organization (WHO) reports that worldwide 7.6 million deaths are caused by cancer each year. Uncontrollable cell development in the tissues of the lung is called as lung cancer. Lung nodule is an abnormality that leads to lung cancer, characterized by a small round or oval shaped growth on the lung which appears as a white shadow in the CT scan. These uncontrollable cells restrict the growth of healthy lung tissues. If not treated, this growth can spread beyond the lung in the nearby tissue called metastasis and, form tumors. In order to preserve the life of the people who are suffered by the lung cancer disease, it should be pre-diagnosed. The overall 5-year survival rate for lung cancer patients increases from 14 to 49% if the disease is detected in time. So there is a need of pre diagnosis system for lung cancer disease which should provide better results.

Index Terms: Lung Cancer Detection system, Median Filter, Watershed Segmentation, Feature Extraction.

1. INTRODUCTION

The mortality rate of lung cancer is the highest among all other types of cancer. Lung cancer is one of the most serious cancers in the world, with the smallest survival rate after the diagnosis, with a gradual increase in the number of deaths every year. There have been a lot of approaches to minimize the fatalities caused by the disease. One approach is to develop new methods for early detection so that treatments will be very effective. The detection of lung cancer can be done in several ways such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI), X-rays and sputum cytology. All these methods consume a lot of resources (money and time of pathologists). In 2012, there were approximately 226,160 new cases of lung cancer and 160,340 related deaths. Lung cancer is one of the commonest cancers in the industrialized world, and persons with this grave disease must deal not only with the physical effects but also with the psychosocial aspects. Survival from lung cancer is directly related to its growth at its detection time. Among different types of cancer the lung cancer is the most aggressive and best practice to its accurate prognosis is the determination of the current stage of the disease.

Medical images are a special mean for controlling the therapeutic action. There are many medical imaging techniques which are used to identify the disease or affected part inside our body. Cancer is one of the important causes of death for both men and women. The early detection of cancer can be helpful in curing the disease completely. So the requirement of techniques for detecting the presence of cancer nodule in early stage is increasing nowadays Lung cancer is a disease that occurs because of unwanted growth in tissues of the lung. If uncontrolled growth detected successfully at early stage, helps to precede with many treatment options, which reduces risk of invasive surgery and increased survival rate. Possible treatments include surgery, chemotherapy, and radiotherapy. Survival depends on stage, overall health, and other factors, but overall only 14% of people who are diagnosed with lung cancer can survive five years after their diagnosis. Sometimes few medical images are not clear to view and identify the stage of disease exactly.

The most common cause of lung cancer is long-term exposure to tobacco smoke, which causes 80-90% of lung cancers. Cancer cells can be carried away from the lungs in blood, or lymph fluid that surrounds lung tissue. Lymph flows through lymphatic vessels, which drain into lymph nodes located in the lungs and in the centre of the chest. Lung cancer often spreads toward the centre of the chest because the natural flow of lymph out of the lungs is toward the centre of the chest. As for the stages, in general there are four stages of lung cancer; I through IV. Staging is based on tumor size and tumor and lymph node location. Presently, CT are said to be more effective than plain chest x-ray in detecting and diagnosing the lung cancer. An estimated 85 percent of lung cancer cases in males and 75 percent in females are caused by cigarette smoking. Objective of this study is to detect lung cancer using image processing techniques. CT scanned lung images of cancer patients are acquired from various hospitals. Using image processing techniques like pre-processing and feature extraction, area of interest is separated. Developing the algorithm, features like area, volume, intensity and entropy are calculated from all the images. The parameter values obtained from these features are compared with the normal values suggested by a physician. From the
comparison result, cancer stage is detected. A graphical user interface is developed to scan all the images and display the features and cancer stage. This system can help in early detection of lung cancer more accurately.

Objective of the project is to increase the visibility of the cancer nodule by proposing a new technique.

2. METHODOLOGY

CT scan images are taken. Smoothing of the images includes suppressing the noise and other small fluctuations in the image by using filter Median Filter. Enhancement of the Image is done to improve perception of information in images for human viewers. Segmentation of the Image is done for partitioning the Image into multiple segments for analysis. Feature Extraction is done to detect and isolate desired portion of image. After Feature Extraction, the Stage of the Tumor of the Lung Cancer in image is identified.

Lung nodules are the smallest growths in the lung that measure between 5 mm to 25 mm in size. In abnormal images nodule size is greater than 25 mm.

Table -1: Cancer Stage Criterion Staging involves evaluation of a cancer size and its penetration into surrounding tissues as well as presence or absence of metastasis in the lymph nodes or other organs.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Tumor Size</th>
<th>Invasion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>&gt;2 cm but &lt;3 cm</td>
<td>Cancer is in initial stage, small tumor is detected</td>
</tr>
<tr>
<td>Stage 2</td>
<td>&gt;3 cm but &lt;5 cm</td>
<td>Cancer is confined to lungs</td>
</tr>
<tr>
<td>Stage 3</td>
<td>&gt;7 cm</td>
<td>Cancer is confined to chest</td>
</tr>
<tr>
<td>Stage 4</td>
<td>Any size</td>
<td>Cancer has been spread from chest to other parts of the body</td>
</tr>
</tbody>
</table>

Stages from I to IV in order of severity

• Stage I: cancer is confined to the lung
• Stage II and III: cancer is confined to the chest
• Stage IV, cancer has spread from the chest to other parts of the body.

The working of the Lung Cancer Detection System is as follows:-

2.1 IMAGE ACQUISITION

First step is to acquire the CT scan image of lung cancer patient. The lung CT images are having low noise when compared to X-ray and MRI images; hence they are considered for developing the technique. The main advantage of using computed tomography images is that, it gives better clarity and less distortion.

2.2 SMOOTHING

For smoothing the image, Median Filter is used. Median filtering is a nonlinear method used to remove noise from images. It is widely used as it is very effective at removing noise while preserving edges. The median filter works by moving through the image pixel by pixel, replacing each value with the median value of neighboring pixels. The pattern of neighbors is called the "window", which slides, pixel by pixel over the entire image. The median is calculated by first sorting all the pixel values from the window into numerical order, and then replacing the pixel being considered with the middle (median) pixel value. It suppresses the noise or other small fluctuations in the image; equivalent to the suppressions of high frequencies in the frequency domain. Smoothing also blurs all sharp edges that bear important information about the image. B=medfilt2 (A[m,n]) performs median filtering of the matrix A in two dimensions. Each output pixel contains the median value in the m x n neighborhood around the corresponding pixel in the image.

2.3 ENHANCEMENT
Enhancement technique is used to improve the interpretability or perception of information in images for human viewers, or to provide better input for other automated image processing techniques.

2.4 IMAGE SEGMENTATION

Segmentation is an important step in medical image analysis and classification for radiological evaluation or computer aided diagnosis. Image segmentation refers to the process of partitioning an image into distinct regions by grouping together neighborhood pixels based on the some predefined similarity criterion. The similarity criterion can be determined using specific properties or features of pixels representing objects in the image. In other words, segmentation is a pixel classification technique that allows the formation of regions of similarities in the image. In medical imaging, segmentation is important for feature extraction, image measurements, and image display. In some applications it may be useful to classify image pixels into anatomical regions, such as bones, muscles, and blood vessels.

2.5 FEATURE EXTRACTION

In the present study, image feature extraction is very important stage of computer based system. Feature extraction provides certain parameters, on the basis of which computer system takes decision. After the segmentation is performed on lung region, the features can be obtained from it and the diagnosis rule can be designed to detect nodules in the lung. The entire feature which are calculated from the image, convey some information regarding lung nodule. This information is very helpful in detecting lung nodule as malignant or non-malignant. In this literature, the features extracted from the X-ray image can be used as diagnostic indicators.

**Area:** Area of the segmented tumor is computed by counting the number of pixels which have the value 1 in the image array. The area (A) in the object is the just the count of the ones in the image array. For computing area, binary image is used.

\[ A = N \left[ \right] \]

Where, \( N \left[ \right] \) represents the count of number of the patterns within the parenthesis.

3. EXPERIMENTAL RESULTS

Different types of stages are as shown in following figures-

3.1 STAGE 1

For Image 1, the area of tumor is 677.1118 sq mm. So, it indicates that stage 1 is detected.

3.2 STAGE 2

For Image 2, the area of tumor is 4037.9068 sq mm. So, it indicates that stage 2 is detected.

3.3 STAGE 3

For Image 3, the area of tumor is 6472.0417 sq mm. So, it indicates that stage 3 is detected.

3.4 STAGE 4

For Image 4, the area of tumor is 9341.1581 sq mm. So, it indicates that stage 4 is detected.

4. PERFORMANCE ANALYSIS

<table>
<thead>
<tr>
<th>Image</th>
<th>Area</th>
<th>Stage Detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image 1</td>
<td>677.1118 sq mm</td>
<td>Cancer is in initial stage, small tumor detected, Stage 1 is detected.</td>
</tr>
<tr>
<td>Image 2</td>
<td>4037.9068 sq mm</td>
<td>Cancer is confined to the Lung, Stage 2 is detected.</td>
</tr>
<tr>
<td>Image 3</td>
<td>6472.0417</td>
<td>Cancer has been confined to the</td>
</tr>
</tbody>
</table>
Cancer has been spread from chest to other parts of the body, Stage 4 is detected.

<table>
<thead>
<tr>
<th>Image 4</th>
<th>9341.1581 sq mm</th>
</tr>
</thead>
</table>

5. CONCLUSION

Lung cancer is a major cause of cancer-related deaths; it can be detected early by detecting the lung nodules at early stage. The main aim of this paper is to detect the Lung Cancer at an early stage so that treatment can be started early and life of the patient can be saved. Using Median Filter is an effective way of detecting the Lung Cancer at an early stage by enhancing the image by noise reduction.

REFERENCES


BIOGRAPHIES

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