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DETECTION OF LUNG CANCER IN CT IMAGES USING IMAGE PROCESSING

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Abstract- Cancer is one of the most serious and widespread disease that is responsible for large number of deaths every year. Among all different types of cancers, lung cancer is the most prevalent cancer having the highest mortality rate. Computed tomography scans are used for identification of lung cancer as it provides detailed picture of tumor in the body and tracks its growth. Although CT is preferred over other imaging modalities, visual interpretation of these CT scan images may be an error prone task and can cause delay in lung cancer detection. Therefore, image processing techniques are used widely in medical fields for early stage detection of lung tumor. This paper presents an automated approach for detection of lung cancer in CT scan images. The algorithm for lung cancer detection is proposed using methods such as median filtering for image preprocessing followed by segmentation of lung region of interest using mathematical morphological operations. Geometrical features are computed from the extracted region of interest and used to classify CT scan images into normal and abnormal by using support vector machine.

Index Terms- CT, Lung cancer, Region of interest, SVM

I. 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. Survival from lung cancer is directly related to its growth at its detection time. But people do have a higher chance of survival if the cancer can be detected in the early stages.

Lung cancer can be divided into two main groups, non-small cell lung cancer and small cell lung cancer. These assigned of the lung cancer types are depends on their cellular characteristics. 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. The earlier the detection is, the higher the chances of successful treatment. An estimated 85% of lung cancer cases in males and 75% in females are caused by cigarette smoking.

II. EXISTING WORK OR LITERATURE SURVEY

B.V. Ginneken, B. M. Romeny and M. A. Viergever, "Computer-aided diagnosis in chest radiography: a survey", IEEE, transactions on medical imaging, vol. 20, no. 12 (2001).

The traditional chest radiograph is still ubiquitous in clinical practice, and will likely remain so for quite some time. Yet, its interpretation is notoriously difficult. This explains the continued interest in computer-aided diagnosis for chest radiography. The purpose of this survey is to categorize and briefly review the literature on computer analysis of chest images, which comprises over 150 papers published in the last 30 years. Remaining challenges are indicated and some directions for future research are given.

This paper is a result of a four-year project on computer-aided diagnosis in chest radiography performed at the Image Sciences Instutute, University Medical Center Utrecht, The Netherlands, which was supported by the Dutch Ministry of Economic Affairs through the IOP Image Processing program.

Beucher, S. and Meyer, F., "The Morphological Approach of Segmentation: The Watershed Transformation," Mathematical Morphology in Image Processing, E. Dougherty, ed., pp. 43-481, New York: Marcel Dekker, 1992.

Image segmentation by mathematical morphology is a methodology based upon the notions of watershed and homotopy modification. This paper aims at introducing this methodology through various examples of segmentation in materials sciences, electron microscopy and scene analysis. First, we define our basic tool, the watershed transform. We show that this transformation can be built by implementing a flooding process on a grey- tone image.

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III. WRITE DOWN YOUR STUDIES AND FINDINGS(PROPOSED WORK)

The proposed system for lung cancer detection in CT images is shown with the help of a flowchart in figure 1.The methodology is carried out in five main steps and each step of this system is discussed in detail in section below.

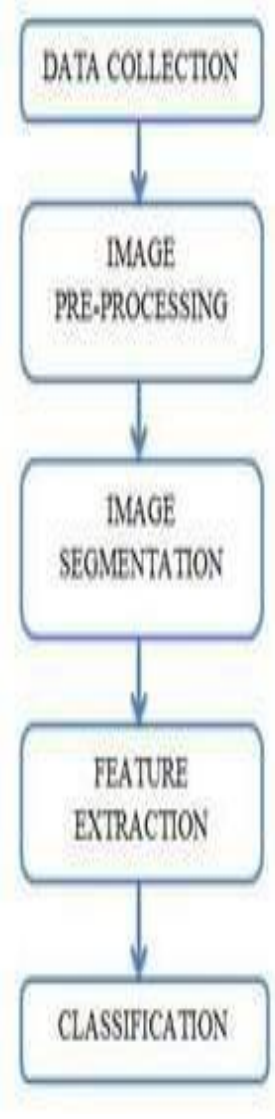

Fig. 1. Block diagram of the proposed system

Data Collection

The first step is to obtain lung CT images of cancer patients. For research work, the images have been downloaded from the Cancer Imaging Archive database. The images are stored in DICOM format. The image database contains Computed Tomography images of patients with and without lung cancer.

Image Pre-Processing

The objective of image preprocessing stage is to suppress unwanted distortions present in the image and to enhance some features useful for further processing. It includes two main steps such as image smoothing and image enhancement. Image smoothing is done to remove unwanted noise present in the image. CT scan images are prone to salt and pepper noise, hence median filtering is found to be quite effective technique in eliminating this impulse noise while preserving the edges. Median filtering gives the best results for image smoothing as it removes noise without blurring the image.

Image enhancement technique improves the quality of digital images to produce better output for further processing. Contrast adjustment is done to enhance the image since image quality is affected by artifacts caused due contrast variations in the image. Contrast adjustment enhances the contrast of an image by transforming input pixel values to new values such that by default 1% data gets saturated at low and high intensity of input image data.

Image Segmentation

The process of separating out required region of interest from the image is known as segmentation. Mathematical morphological operations are powerful tools in acquiring lung region from binary images. In our methodology, first the preprocessed gray scale images were converted to binary images. Morphological opening operation was performed to the binary image with disk structuring element for removal of unwanted components from the image. The opened image was then complemented and clear border operation was performed to it. The lung masks were obtained by filling the holes and gaps present in the lungs. Finally exclusive OR operation was performed to lung mask output and clear border output to give us the segmented tumor region.

Feature Extraction

Feature extraction is the most essential step that transforms input data into required features. This stage extracts out significant features of segmented region of interest and these features serve as input for classification of CT scan images. The size and shape of tumor present in the lungs is estimated by extracting three geometrical features. The features are area, perimeter and eccentricity of cancerous lung nodule.

1. Area: This is a scalar quantity which gives total number of pixels acquired by cancerous lung nodule. The area is evaluated from the binary image by taking summation of pixel areas in the image that are registered with value

2. Perimeter: This is a scalar quantity that gives the total pixels present at the border of the lung tumor. The perimeter is evaluated from the binary image by summing the pixels registered with value 1, at the outline of lung nodule.

3. Eccentricity: This metric value is also referred to irregularity index (I) or circularity or roundness. For a circular shape eccentricity value is equal 1 and the value is less than 1 for any other shape.

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Eccentricity =length of major axis /length of minor axis

Classification

The Classification stage involves labeling the CT scan images as normal and abnormal. In our method SVM algorithm will be used for detection of lung cancer in CT images. SVM classifiers are supervised learning models that analyze input data and classify them according to pattern. The SVM classifier builds a model by using training dataset and categorizes it into two classes. The SVM algorithm then assigns new examples of testing dataset to one of the two classes. SVM classifier thus finds the best hyper plane that separates the two groups and thus classifies the lung CT images. For the best hyper plane data points of one class are separated from the other by largest margin between the two classes.

IV. RESULTS AND DISCUSSION(IF ANY)

Gabor filters enhancement technique: The Gabor filter was originally introduced by Dennis Gabor, we used it for 2D images (CT images). The Gabor function has been recognized as a very useful tool in computer vision and image processing, especially for texture analysis, due to its optimal localization properties in both spatial and frequency domain.

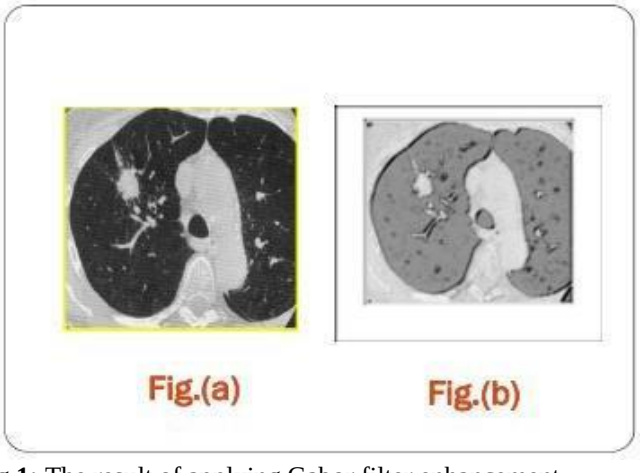

Fig 1: The result of applying Gabor filter enhancement technique: Fig.(a) Original Image Fig.(b) Enhanced Image

Fast Fourier Transform technique:

Fast Fourier Transform technique operates on Fourier transform of image. The frequency domain is a space in which each image value at image position F represents the amount that the intensity values in image I vary over a specific distance related to F. Fast Fourier Transform "FFT" is a faster version of the Discrete Fourier Transform (DFT).

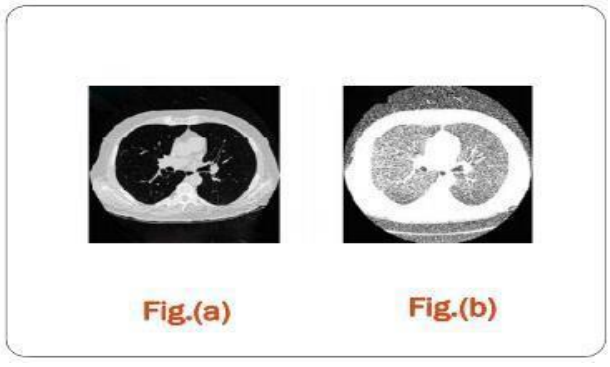

Fig 2: The result of applying FFT enhancement technique: Fig.(a) Original Image Fig.(b) Enhanced Image

V. CONCLUSION

Lung cancer is the most dangerous and widespread in the world according to stage the discovery of the cancer cells in the lungs, this gives us the indication that the process of detection this disease plays a very important and essential role to avoid serious stages and to reduce its percentage distribution in the world. To obtain more accurate results we divided our work into three stages: Image Enhancement stage, Image Segmentation stage and Features Extraction stage. Lung Nodule Detection in CT Scans is an active area of research which is continuously emerging and there are many enhancements that can be included to make more efficient

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