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Machine Learning Driven Lung Cancer Classification on Computer Tomography

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ABSTRACT: The lung carcinoma, known as lung cancer has become worldwide health problem. The lung tumor segmentation on CT images is a very difficult and important task in surgical planning and assessments. The manual segmentation will be time consuming. This project presents an overview of the pre-processing, segmentation, feature extraction and classification in CT images. A novel segmentation algorithm is used to detect the tumor area ,position of the tumor and estimate the size of the tumor. GLCM is used to extract features from segmented result. Genetic Algorithm is used select the features. Artificial Neuro Fuzzy Inference System will be employed for classification, in order to classify the lungs as benign or malignant lung.

KEY WORDS: FBB, GLCM.

I. INTRODUCTION

The lung cancer is the leading cause for cancer death. The WHO (World Health Organisation) presents 2015 world health statistics on lung cancer which figures out 157,499 people death rate.

The assessment of the lung tumor of patients is very informative in clinical practice. The most important task is the early detection of tumor in lungs and provide treatment for protection of lungs.

Segmentation is a pivotal and necessary component of image analysis system. The result of image segmentation is a agglomeration of segments which combine to form the entire image. The different methods have been proposed for segmenting an image in a better way.

The lungs are pair of mushy air-filled organs located on either side of chest. The trachea allows inhaled air into the lungs through the tubular branches called bronchi. The bronchi is divided into smaller bronchioles finally becoming microscopic. The bronchioles finally end in clusters of microscopic air sacs which is known to be called alveoli. In the alveoli, oxygen from air is absorbed into blood. The lungs are covered by a thin tissue layer called the pleura. A thin layer of fluid act as a lubricant allowing lungs to glide smoothly as they expand and contract with each breathe.

Cancer refers to a hierarchy of diseases affecting the healthy cells with more than 100 known types. Depending on the properties of the infected cells, there exist two types of cancer. They are benign and malignant types. The benign cell is limited to certain confinements in the body, do not entrench or spread to new locations. On the contrary, malignant cancer cell is represented by their nature of uncontrolled growth, intruding and destroying nearby cells and spreading to fresh locations of the body.

Currently there exist many algorithms for lung image segmentation. Samuel G. Armato III and William F. Sensakovic (2004) [11] proposed the use of gray-level thresholding to segment the lungs within each computed tomography section. The segmentation is done through separation of right and left lungs along the anterior junction line, elimination of the trachea and bronchi from the lung segmentation regions, and elimination of the diaphragm regions.

Khin Mya Mya Tun and Aung Soe Khaing (2014) [7] proposed a methodology of Otsu's thresholding Methods for the segmentation of cancereous or tumor region from CT Medical Images. It is a time consuming process which finds high noise in segmented image.

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Baidya et al. (2012) [2] proposed bounding box segmentation within axial brain MR images. This is completely unsupervised and also very efficient novel segmentation.

Saeid Fazli and Parisa Nadirkhanlou (2015) [9] proposed the methodology of Fast Bounding Box algorithm for Image Segmentation. This algorithm employs the novel score function that can identify the region of change with brain image vertically and horizontally.

II. METHODS AND MATERIAL

A. Pre-processing

The pre-processing phase plays vital role in the applications of image processing. The main goal is to remove the noise in the image and increase the visual perception of an image.
Noise is the unwanted variations or dissimilarity of the image. The difference are caused due to errors in the sensors or data transmission which corrupts the image details either by causing changes in brightness or frequency.

Anisotropic diffusion filter is a proposed by Persona and Malik [9] for removing noise. This method is for smoothing the image by preserving the edges and structures. The smoothing level in a region is adjusted by filter based on the edge structure in the neighbourhood. Homogenous regions are highly smoothed and strong edge regions are barely smoothed. It is used because of high precision and dependability.

B. Segmentation

The segmentation is the process of partitioning a digital image into multiple segments. The goal of segmentation is to elucidate and/or vary the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is used to locate objects, edges and boundaries (lines, curves, etc.) in images.

The result of image segmentation is a assortment of segments that covers the entire image, or a set of contours extracted from the image. Each of the pixels in regions is identical with respect to some characteristics or calculated properties, such as color, dissimilarity, intensity, or texture. Neighbourhood regions are significantly different with respect to the same characteristics.

C. Segmentation using FBB

FBB [8] is a novel fast segmentation technique that uses symmetry to enclose an anomaly (typically tumors) by bounding box within a CT lung images. In each input CT slice, there is a left–right axis of symmetry of the lung. A tumor which is considered an abnormality in the lung , typically perturbs this symmetry.

The lungs containing gray level intensity histograms of the inside of the two rectangles are most dissimilar and the outside of the rectangles are similar. A novel score function [12] utilize that can identify the region of change with two fleetly searches along the horizontal and vertical direction of the image. Bhattacharya coefficient (BC) measures resemblance between normalized gray level intensity histograms of horizontal and vertical direction. The BC value is 1, when two normalized histograms are the same, and remains 0 when the histograms differ.

In FBB approach with consideration of gray level intensity histogram of similarity and dissimilarity regions, then Bhattacharya coefficient value is calculated and the tumor region is automatically marked by a bounding box and the tumor position is separated from the healthy textures.

III. PROPOSED METHOD

In this article, segmentation algorithm for tumor segmentation of CT lung image is given
The pre-processing involves two steps:

1. The first stage involves removal of unwanted parts.
2. The second stage is to remove noise and piecewise smoothening. The edges are preserved for further segmentation process. The anisotropic diffusion filter is used for better contrast and noise removal.

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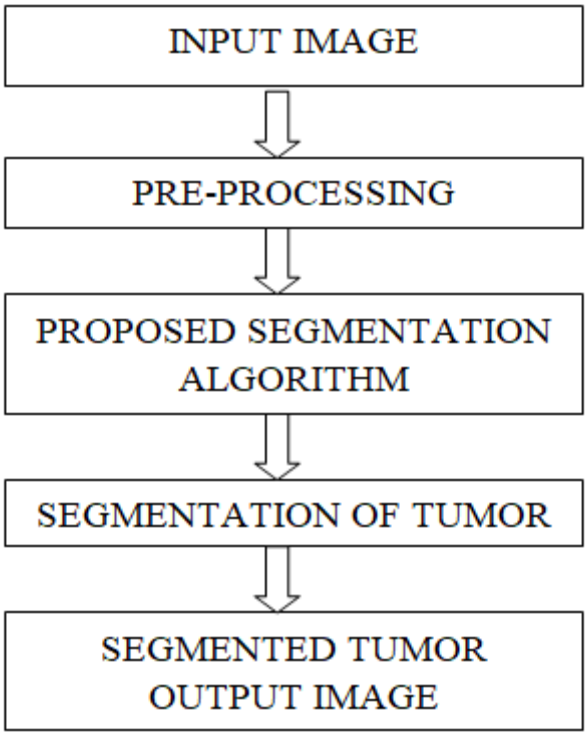

Fig 1 shows the block diagram of the proposed algorithm.

The proposed algorithm uses fast bounding box segmentation which is unsupervised change detection method to detect the region of interest. The dissimilar region of lungs in detected using novel score function based on Bhattacharya coefficient with the gray level intensity histograms.

Steps involved in FBB algorithm are as follows:

1. Axis of symmetry on CT image is found.
2. Region of change is found along the vertical and horizontal direction using novel score function.
3. Region of change is associated with local pixel to pixel change.
4. Novel score function uses Bhattacharya coefficient which is used to calculate histogram.
5. If normalized histograms are same then BC =1 and if it dissimilar then BC =0.
6.

IV. EXPERIMENTAL RESULTS

The detection and segmentation of lung tumor is performed using 50 CT images of different patients. The test lung image has tumor of different size and shape. The figure.2 shows the experimental results for different CT images containing tumors.

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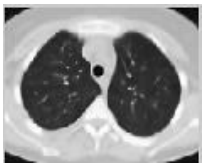
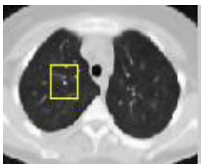
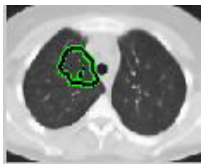
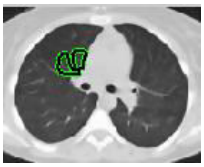
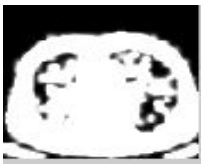
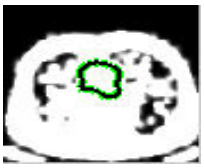
SAMPLE	ANISOTROPIC DIFFUSION FILTERED IMAGE	LOCATING BOUNDING BOX	SEGMENTING TUMOR REGION	TUMOR OUTPUT
IMAGE-1				
IMAGE-2				
IMAGE-3				

V. CONCLUSION

In this article an efficient algorithm for lung tumor segmentation is proposed. Tumor images are segmented by using fast bounding box segmentation algorithm. The segmentation algorithm works well for cancer lung images and the position of the tumor cells are segmented in efficient manner.

In future, the segmented result is used to extract features using GLCM and tumor is classified either as benign or malignant using ANFIS.

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