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Lung Cancer Detection System on Thoracic CT Images Based on ROI Processing

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Abstract: The goal is to outline and to develop programmed system for detecting lung cancer and to build efficient outcome within an interactive time frame with least false negative rate. Many systems ensue to increase the accuracy and performance rate. Many imaging techniques are now accessible in the field of medical analysis such as computed tomography (CT), radiography, and magnetic resonance imaging (MRI). Medical image segmentation is very delicate part in analyzing the image. A new approach is used to segment the images and to classify focal areas in lung region. Instead of simple thresholding; adaptive threshold method is applied on dicom images and ROI processing is used to segment the cautious region. Experiments are accomplished using real time datasets to scrutinize our method.

Keywords: Computed Tomography, Gray level Co-occurrence Matrix, Lung Cancer, Minimum False Negative Rate, Neural Network Classifier, ROI, Segmentation.

I. INTRODUCTION

Cancer is an affliction which is found everywhere today at every corner of the world. It is major cause of death. Lung Cancer is the deadliest of all cancers.

The number of deaths due to lung cancer has increased approximately 3.5 percent between 1999 and 2012 from 152,156 to 157,499. It is the leading cancer killer in both men and women.

The number of deaths among men has reached a plateau but the number is still rising among women. Lung cancer caused more deaths then the next 3 most common cancer combined (colon, breast, Pancreatic) and has been taking attention of medical sciatic communities.

Statistics according to the American Cancer Society, In 2014, about 224210 new cases of lung cancer (116,000 in men and 108,210 in women) and an estimated 159,260 deaths from lung cancer (86,930 in men and 72,330 among women) were found in the United States.

Lung cancer is uncontrolled growth of abnormal cells which starts off in one or both lungs. Lung Cancer has broadly main two types depending upon cancer appearance under microscopy: Small Cell Lung Cancer (SCLC) and Non Small Cell Lung Cancer (NSCLC) also known as Large Cells Lung Cancer.

There are four types of NSCLS: Squamous Cell carcinoma, Adeonocarcinoma, Bronchioalveolar Carcinoma, Large-cell Undifferentiated Carcinoma. Computed Tomography (CT) Scan images are the most promising way to detect lung nodule and to diagnose cancer.

The schema of this system is shown below:

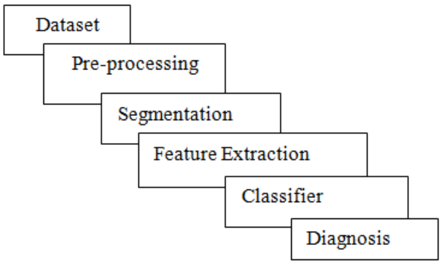

Figure 1: Basic steps of Image Processing

The goal of this system is to detect cancer nodules with minimum false negative rate. The proposed system consists of some steps such as: collect lung CT scan image dataset, pre-processing, extraction of the lung region using ROI, feature extraction and to train the classifier to classify the images as normal or abnormal. This paper is organized as follows: section 2 comprises Methodology; section 3 comprises Experimental Results and Conclusion is in section 4.

II. METHODOLOGY

Following flow explains the methodology of proposed system and detect whether lung ct image is healthy or not.

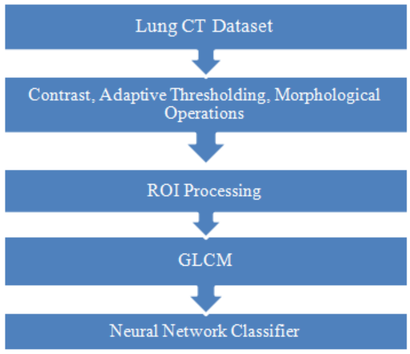

Figure 2: Proposed Techniques.

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1. *Image Preprocessing*.

Image Preprocessing is a process which eliminates image distortion and enhances important features. By using this process a corrected image produced. Matlab software was used for applying preprocessing approach.

A. Adaptive Thresholding

Thresholding is used to segment an image by adjusting all pixels whose intensity values are above a threshold to a foreground value and all the remaining pixels to a background value.

Whereas the conventional thresholding operator uses a global threshold for all pixels, adaptive thresholding switch the threshold over the image dynamically. This more sophisticated version of thresholding can contain changing lighting conditions in the image, *e.g.* those occurring as a result of a powerful illumination gradient or shadows.

Adaptive thresholding in fact takes a grayscale or color image as input and, in the simplest implementation, results a binary image presenting the segmentation. A threshold has to be estimated for each pixel. If the pixel value is less the threshold it is set to the background value, otherwise it is considered the foreground value.

There are two main approaches to determine the threshold: (i) the *Chow and Kaneko* approach and (ii) *local* thresholding. The theory behind both methods is that smaller image regions are more accepted to have maximum uniform illumination, hence being more suitable for thresholding. Chow and Kaneko isolate an image into an array of overlapping sub images and then find the highest threshold for each sub image by investigating its histogram. The threshold for each single pixel is obtained by interpolating the results of the sub images. The disadvantage of this method is that it is computational expensive and, therefore, is not correct for real time applications.

Another approach to search the local threshold is to statistically examine the intensity values of the local neighbourhood of each pixel. The statistic which is most relevant depends largely on the input image. Simple and fast functions carry the mean of the local intensity distribution.

T= mean, or

T= median

T= (max+ min)/2 (the mean of the minimum and maximum values)

The size of the neighbourhood should be large enough to cover enough foreground and background pixels, otherwise a poor threshold is taken. On the other hand, selecting regions which are too large can violate the assumption of almost uniform illumination. This method is less computationally completed than the Chow and Kaneko approach and generates good results for some applications.

B. Morphological operations

Morphological operations are used to affect the form, structure or shape of an object [12]. They are applied on binary images and also used in pre or post processing like filtering, thinning, and pruning or for getting a picture or description of the shape of objects/regions such as boundaries, skeletons convex hulls. To remove the background noise and to remove small objects, several morphological operations can be performed

Common Morphological operations such as opening, closing, dilation, erosion etc can be performed.

2. ROI processing For Segmentation

A region of interest (ROI) is a portion of an image that can be filter or perform some other operation on. One can define an ROI by creating a *binary mask*, which is a binary image that has exact size as the image you want to process with pixels that define the ROI set to 1 and all other pixels set to 0.

More than one ROI in an image can be defined. The regions can be geographic, such as polygons that encompass contiguous pixels, or they can be specifying by a range of intensities. In the latter case, the pixels are not compulsory contiguous.

3. Gray Level Co-occurrence Matrix for Feature Extraction

A statistical method of examining texture that assumes the spatial relationship of pixels is the gray-level co-occurrence matrix (GLCM) and also known as the gray-level spatial dependence matrix. The GLCM functions differentiate the texture of an image by estimated how often pairs of pixel with particular values and in a prescribed spatial relationship appear in an image, generating a GLCM, and then extracting statistical measures from this matrix.

GLCM is created by using the graycomatrix function and by determining how often a pixel with the intensity (gray-level) value *i* occurs in a specific spatial relationship to a pixel with the value *j*. The spatial relationship is stated as the pixel of interest and the pixel to its immediate right (horizontally adjacent), but you can mention other spatial relationships between the two pixels. Each element (*i*,*j*) in the resultant glcm is the sum of the number of times that the pixel with value *i* occurred in the prescribed spatial relationship to a pixel with value *j* in the input image.

The number of gray levels in the image find the size of the GLCM. Graycomatrix uses scaling to minimize the number of intensity values in an image to eight defiantly, but you can use the NumLevels and the Gray Limits parameters to control this scaling of gray levels.

The gray-level co-occurrence matrix can reveal certain properties about the spatial distribution of the gray levels in the texture image. For instance, almost all of the entries in the GLCM are concentrated along the diagonal; the texture is dirty with respect to the specified offset. You

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can also determine several statistical measures from the GLCM such as angular moment, correlation, contrast, sum variance, energy entropy, cluster prominence, cluster shade, sum entropy, sum variance, sum average, autocorrelation, dissimilarity, info measure of correlation 1, info measure of correlation 2, inverse difference moment, difference variance, difference entropy, sum of square variance.

4. Neural Network Classifier For Classification

An artificial neural network is an interconnected group of nodes, related to the wide network of neurons in a brain. Here, each circular node denotes an artificial neuron and an arrow stand for a connection from the output of one neuron to the input of another.

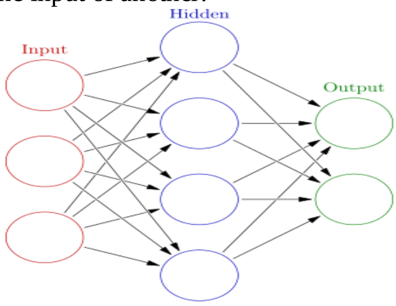

Figure3: Neural Network (Multi- Layer Perception)

In machine learning, artificial neural networks (ANNs) are a family of statistical learning algorithms inspired by biological neural networks (the central nervous systems of animals , particular the brain) and are used to estimate or approximate functions that can depend on a large number of inputs and are mostly unknown. Artificial neural networks are mostly presented as systems of interconnected "neurons" which can compute values from inputs, and are adequate of machine learning as well as pattern recognition.

III. EXPERIMENTAL RESULTS

The experiments are performed on lung cancer detection system with the help of real time lung images. The datasets consists of 48 patients which has 6000 slices (Normal and Abnormal). The format of image is DICOM and original CT image is been pre-processed by several techniques of image processing and it is been segmented by masking ROI with original dicom image. The results of pre-processing stage and segmentation of abnormal image is shown in Figure 4.

Figure 4a: Original CT Scan Image

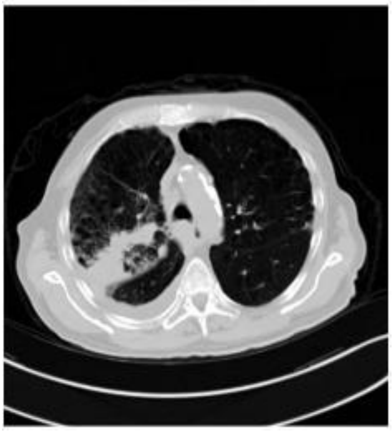

Figure 4b: After Adjusting Contrast

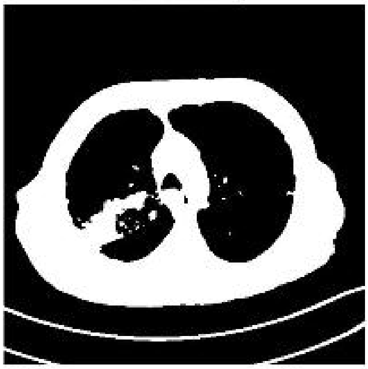

Figure4c: Represents image after applying Adaptive Threshold

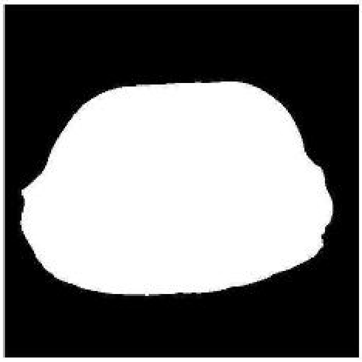

Figure 4d: Represents ROI

Figure4e: Result of proposed approach after Segmentation

IV. CONCLUSION

The system is designed to detect cautious region automatically without any human interruption. After pre-

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processing stage, several morphological operators are tested on the image to find the region of interest and image is segmented by masking ROI with original image. The segmented region from the proposed work can be used for further processing such as feature extraction and classification stage in future. Hence the proposed work is highly desirable to classify lung nodules and to raise the diagnostic accuracy.

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BIOGRAPHIES

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