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LUNG CANCER DETECTION SYSTEM ON CT IMAGES- A SURVEY

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Abstract: Now a days, it's our central duty to forecast and to investigate cancer on daily bases. Cancer is the top most cause of death worldwide. In this research paper we presented several techniques to detect lung cancer at early stages. Image Processing acts as a serious role in cancer detection when input dataset is in the form of images; some techniques generally used in Image Processing for information retrieval such as Noise Removal, Image acquisition, Morphological operations, Segmentation, Feature Extraction etc. The objective is to design and to develop automatic diagnostic system for detecting Lung Cancer and to make efficient decision within an interactive time frame with minimum false negative rate. Lung Cancer recognized differently because of its highest occurrences as well as highest mortality rate compared with other types of cancers. To diagnose the cancer, this paper present various existing techniques of image processing and their efficiency used for prediction and analysis on computed tomography (CT) scan images.

Keywords: Computed Tomography, Detection System, Image Processing, Lung Cancer, Minimum False Negative Rate, Noise Removal, Segmentation

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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 called 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:

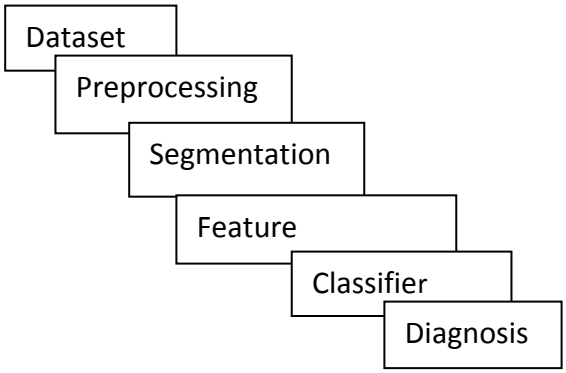

Figure 1: Basic steps of Image Processing

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, preprocessing, 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 Previous Work; section 3 Summary Of existing methods and conclusion is in Section 4

RESEARCH WORK

Hao Han, Lihong Li et.al [1] proposed a novel system CADe (computer-aided detection) for fast and adaptive detection of pulmonary nodules in thoracic CT images via hierarchical vector quantization method. The high level VQ gives more accurate segmentation of the lungs from chest volume is used for segmenting lung region. The low level VQ proved effective for INCs detection and segmentation. False-positive reduction was obtained by using rule-based filtering operations in combination with a feature-based support vector machine classifier. This system was validated on 205 dataset from the publically available on-line LIDC (Lung Image Database Consortium) database. Finally, diagnostic indicator achieves sensitivity of CADe system 82.7% at specificity of 4 FPs/scan.

Ada, Rajneet Kaur[2] developed automated diagnostic system for early detection and prediction of Lung cancer survival using neural network classifier to check the state of a patient in its early state whether it is normal or abnormal. In the preprocessing stage, histogram equalization is used on images. Features are extracted via GLCM, Binarization approach and PCA. He had shown results on 909 CT images of different classifier by using WEKA data mining tool.

Fatma Taher et.al [3] described a Bayesian classification and a Hopfield Neural Network algorithm for extracting and segmenting the sputum cells for the purpose of lung cancer early diagnosis. The HNN segmentation algorithm outrun the Fuzzy C-Mean clustering and gave successful results after extraction of nuclei and cytoplasm regions. HNN algorithm outperforms better results after using morphological operations on the segmented area.

Anita Chaudhary et.al [4] aimed to get the better results by using various enhancement and segmentation techniques. MATLAB had used through every procedures and in image processing procedures, process such as image pre-processing, segmentation and feature extraction are discussed . Compare Gabor filter, auto-enhancement and Fast Fourier transform techniques, used for image enhancement. In the segmentation stage the Watershed and Thresholding Segmentation is used and comparison has been made.

Atiyeh Hashemi et.al [5] presented a method to get improved results from lung cancer diagnosis system via region growing segmentation method to segment CT scan lung images. To remove noise from the image, linear filtering and contrast enhancement method is used as preprocessing. To differentiate between malignant, benign and advanced lung nodules, Fuzzy Inference System (FIS) was used. The diagnostic performances of FIS system is compared with artificial neural networks (ANNs).

Disha Sharma et.al [6] developed an automatic CAD system for early detection of lung cancer by analyzing LUNG CT images. First, extracting the lung regions from the CT image using several image processing techniques, including bit image slicing, erosion, and Weiner filter. To convert the CT image into a binary image, Bit plane slicing techniques is used in the extraction process. After extraction, the extracted lung regions are segmented using region growing segmentation algorithm. To classify cancer nodules rule based technique was used. From the extracted features, set of rules were generated and diagnostic indicator achieved accuracy of 80%

Zhenghao Shi et.al [7] presented a computer aided pulmonary nodule system for chest radiography. The system was proposed to resolve the problem of positive reduction in lung nodule detection by using multiple massive training SVMs.

Jiamin Liu et.al [8] described fully automatic method for mediastinal lymph node detection and station mapping on computed tomography using spatial prior. Spatial Prior distribution is obtained by using multilabel fusion based on 11 anatomical structures. Method was applied on 20 patient dataset with 62 enlarged mediastinal lymph nodes. System achieved 80% sensitivity at 8 FP per patient with spatial prior compared to 45% sensitivity at 8 FP per patient without spatial prior.

Nooshin Hardavi et.al [9] proposed CAD system on cellular learning Automata to diagnose Lung cancer using CT- scan Images. Preprocessing method such as Gabor filter was used for filtering and region growing algorithm to segment lung nodule to obtained improved CT images. He proposed the idea to reduce the error rate.

Anam Tariq et.al [10] described computerized system for lung nodule detection in CT scan images. The system consists of two stages such as lung segmentation and enhancement, feature extraction and classification. To remove background noise and to extract nodule from the image, threshold segmentation is applied. For possible unhealthy regions a feature vector is calculated and neuro classifier is used to classify regions.

S. Shaik Parveen et.al [11] described detection of lung cancer nodules via automatic region growing method. In the preprocessing stage, median filter is used for enhancement and for noise removal. He identified focal areas in lung nodules to segment CT images and experiment is performed on real dataset i.e. on 3000 images.

Shanhui Sun et.al [12] presented automated approach for segmentation of lungs with high density pathologies. A novel robust active shape model (RASAM) matching method used to segment the outline of the lungs and also optimum surface finding method is adapted to find

out results of the initial segmentation. It is evaluated on 40 abnormal images and 20 normal images.

SUMMARY

In medical areas, image processing has shown remarkable improvement in terms of decision and prediction of lung cancer. Table.1 gives the summary of image processing and various techniques and performance parameters used.

Table 1: Summarization of Image Processing Techniques and their Results

Sr. No.	Author	Year	Techniques	Images	Datasets	Performance
1.	Nooshin Hardavi et.al [9]	2014	Thresholding, Gabor Filter Cellular Learning Automata, Region Growing,	CT	60	100%:healthy images 90% :Cancer Cases
2.	Hao Han, Lihong Li [1]	2013	Adaptive thresholding, Hierarchical vector quantization algorithm for segmentation, Rule based Filtering, PCA, and SVM classifier.	CT	205(LIDC)	Accuarcy:82.7% Sensitivity:4FPs/scan.
3.	Ada, Rajneet Kaur[2]	2013	Histogram Equalization, Morphological Operators, GLCM, Binarization, PCA and comparison on Neural Network, Zero R, Navie Bayes, SVM.	CT	909(Real Time)	NN : 96.4%, Zero R : 53.30% Navie Bayes: 63.44% SVM : 72.69%
4.	Zhenghao Shi [7]	2013	Self-adaptive thresholding, Rule based classifier, Multiple Massive Training SVMs, comparison shown with FLD classifier.	X-ray	60 datasets	Over all Sensitivity 85%, SVM CAD:83% FLD CAD:81%
5.	Atiyeh Hashemi [5]	2013	Region Growing, FIS Artificial Neural Network.	CT	1000 patients	Sensitivity :95%
6.	Jiamin Liu[8]	-	ROI, Spatial Prior from Multi-Atlas label Fusion, GLCM, SVM.	CT	20 patients	Sensitivity 80% at 8FP
7.	Anam Tariq [10]	2013	Threshold Segmentation, Neuro Fuzzy	CT	LIDC	Accuracy :95%
8.	S. Shaik Parveen[11]	2013	Median Filter, ROI, Region growing,	CT	11(3000)	Shown CT image of benign
9.	Mokhled S. Al-Tarawneh	2012	Comparison is shown between Gabor filter ,FFT and Gabor and Threshold Segmentation and watershed filter, Also used	CT	IMBA Home	Gabor Filter:80.73 FFT:27.51 Thresholding:81 Watershed Filter

			masking and Binarization for decision making(normal an abnormal)			:85.16.83
10	Anita Chaudhary [4]	2012	Shown comparison of Gabor Filter , Watershed algorithm and Threshold segmentation ,FFT	CT	-	Shown Normal and Abnormal segmented CT of Stage I and II. Shown Feature values of both stages
11	Shanhui Sun[13]	2012	Robust Active shape Model(based on region growing) ,Rib cage detection method, Optimal Surface finding(based on deformable template)	CT	40 Abnormal, 20 Normal	Experiments on the 30 data sets are shown that RASM delivered statistically significant better segmentation results, compared to ASM.
12	Disha Sharma [6]	2011	Edge Detection (Sobel), Diagnostic Indicator	CT	1000 images (LIDC)	Accuracy: 80%

1. CONCLUSION

This paper shows an analysis of different image processing techniques and methods which are used in detection and prediction of automatic lung cancer system. Overall review of different algorithms and different classification techniques of image processing is presented. The main focus is on different classifiers and segmentation algorithms for lung nodule detection using image processing on CT images. The summary of segmentation and classification techniques with their classification accuracy, sensitivity of lung cancer system has been shown. From the above study, it is clear that, Thresholding segmentation, Neural Network classifier, Neuro fuzzy has better results than other techniques.

2. ACKNOWLEDGMENT

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