Artificial Neural Network-Based System for Lung Nodules for Early Detection of Lung Cancer

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Abstract: Amongst diverse cancers, cancer of lung be measured the foremost reason of cancer demise including utmost demise pace. Nodules lying on lungs have distinct structure circle otherwise coiled and during various circumstances composes the recognition complex. In this learning, system has been urbanized for detection before time via images from Computerized Tomography (CT) scanner along with distinguishes among malignant and benign tumors. Lung cancer detection process has four steps towards detecting the existence of cancer nodule within lung. Pre-processing phase, segmentation, feature extraction and lung cancer cell classification are the steps. Pre-processing stage includes image enhancement. Improved CT image of lung after that conceded all the way through segmentation stage. Commencing the segmented output features be extracted to visualize the occurrence of deformity of lung. The planned scheme gives nodules segmentation lying in particular section with Watershed Transform as well as ensures classification among malignant nodules and benign through Artificial Neural Network. The accuracy and sensitivity of 90% and 93.30% is acquired within the system.

Keywords: Lung cancer, CT Images, Watershed Transformation, Graylevel co-occurrence matrix (GLCM), Artificial Neural Network (ANN) Classification.

Introduction

These days, lung cancer be the for most part of lethal types of cancer. Cancer of lung patients is intended for variety of curing methods like surgery, radiotherapy as well as chemotherapy [1]. For cancer of lung, 5 year endurance speed meant for these patients has been lower down to 14 %. Conversely, during another types of cancer, endurance pace may possibly rise and reaches about 49 % with the condition that it is recognized before time [2]. Identifying nodules before time is tough as evidences turn out scarcely in the higher phase leading death pace to be maximum amongst other cancer types. As compared with diverse cancer forms like thyroid, pancreatic and bladder, most population passes away through cancer of lung. Evidences for cancer of lung includes breath conciseness, out of breath, upper body throbbing which is no more getting healthier, choking accompanying red liquid, deglutition complexity, thrashing of weight along with appetite. There are considerable facts representing that mortality pace can be reduced by before time recognition about cancer of lung. Current assessment given by recent data presented via health association reveals that due to cancer of lung about 7.6 million demises all around the world. In addition, fatality coming out of tumor is headed for growing, and turns out to be around 17 million globally in 2030.

To identify cancer of lung, with utmost persistence Computed Tomography be used. Medicinal leftovers as well as nodules with different length can be contentedly examined with Computed Tomography [3]. Lumps present above the lobe of lung are categorized as malignant else benign. In few situations lumps that are firm as well as uncommon termed as malignant are evaluated like benign through diagnosis. Nevertheless, nearly everyone's case, firm lumps are typically categorized like malignant [4]. So diagnosis before time is vital so as to increase speed of medical aid.

Computer Aided Diagnosis technique planned in order to surgical applications gives distinct advantages as thriving recognition about lumps. With these techniques medication procedure should be started before time as well as help in directing procedure for surgeons. Such mechanized system would allocate objective and unbiased estimation, as compared to human appraisal which may be corrupted with errors. In the long run, this system will be helpful for managing large image database as well as relieving the pathologist from monotonous routine task.

Literature Survey

The researcher in the paper [4] urbanized different technique about automated recognition of nodules of benign. For this

Genetic Algorithm based predictable pattern identical method was used inside the area of lung as well as adjacent to wall of lung on CT images. 72% of nodule recognition was possible through this technique. The researcher in the paper [5] recommended Computer Aided Design scheme using fuzzy in order to identify lumps. The researcher in the paper [9] for the automatic detection of lumps used Bayes classification and obtained an accuracy of 80%.The researcher in the paper [8] projected a template identification method depends upon Artificial Neural Network with images of lowdose Computed Tomography to increase accuracy. They trained Multi-MTANN to decrease false positives reported by recent mechanized design for lung nodule recognition. The result indicates that 83% of nodules that do not contain cancer be separated and decrease in nodules that contain cancer. The researcher in the paper [7] projected Computer Aided Diagnosis scheme that automatically categorize lumps. They used new system for detection of nodules on the basis of classification of hierarchic blocks. For classification of features to be extracted SVM was used. In addition around various Artificial Neural Network base Computer Aided Diagnosis are present in the paper. The researcher in the paper [6] uses via Computed Tomography images and planned Computer Aided Diagnosis scheme in order to identify nodules which can be cured. In this paper image processing was used to find ROI. The nodule recognition system performed at a pace of just about 65.4 %.The researcher in the paper [10] projected a scheme for early analysis of lung cancer using Artificial Neural Network. The projected scheme obtained an accuracy of 90%.The researcher in the paper [11] proposed CAD system in which lungs images that is Computed Tomography images were urbanized via Artificial Neural Network. Though, the accuracy of this study was not adequate in order to assemble needs for medical applications. In addition, early-detection of lung nodule is not focused in this study. They do not contain any proposal for the recognition of small dimension nodules. The researcher in the paper [12] projected a scheme for early analysis which helps in curing as well as increases survival rate of patients. In this study CAD scheme was urbanized via Computed-Tomography (CT) images so as to differentiate among cancer which can be cured and cancer which cannot be cured.

In this paper, Watershed Transformation has been used for nodule segmentation. GLCM technique has been applied for the feature extraction. ANN has been engaged for classification. To categorize malignant or benign nodules during early phase Artificial Neural Network is used. ANN is statistical form which replicates the network as well as functions of biological neural network.

The planned CAD system consists of four main phases:

I. Pre-processing
II. ROI to be Segmented
III. Extraction of Features
IV. Categorization of Malignant or Benign nodules

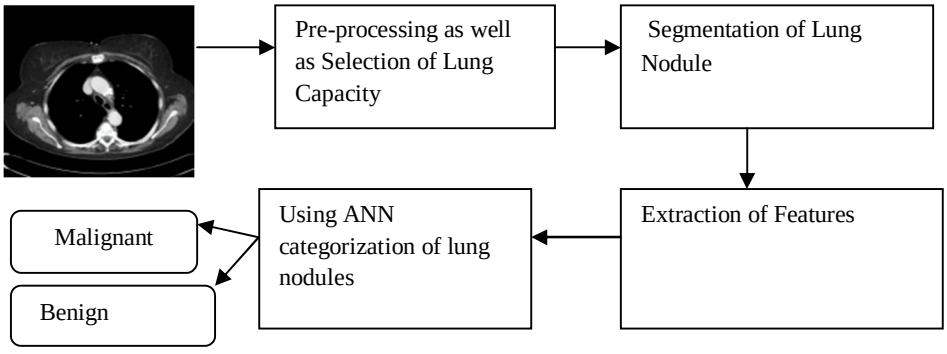

Fig.1 Block diagram of the system

Present Work

Step1 Pre- processing as well as Selection of Lung Capacity:- This phase starts through image improvement; the aspire for the improvement in the images to make them more of illustratable and to get better observation of data incorporated within the image, as well as gives enhanced images as input to other computerized schemes. Median filter was used to eliminate noise. For the allotment of stable pixel values histogram has been used. Pre- processing enhances image quality and removes noise.

Step2 Segmentation of Lung Nodule:- The principle of segmentation of an image involves interested digital image to be partitioned in significant regions with reverence to some decisive factors like colour, texture or intensity. Segmentation of image is an important process and is necessarily used in large number of medicinal treatments. In this study, Watershed Transform is used for image segmentation. The Watershed Transform uses growing of region scheme depending upon

gradient of image which makes watershed transform a distinctive technique for segmenting digital images. In this method the resulting margins appear closed and linked regions. Based on these advantages Watershed Transformation is used.

Step3 Extraction of Features:-Feature extraction is an essential action to be done in manufacturing any pattern and aims at taking out relevant information that characterizes each class. Feature extraction is the method to recover the significant data from the unprocessed data. It is used to find the set of parameter that defines the shape of a character accurately and distinctively. In this study for extraction of features gray level co-occurrence matrix has been used. In comparison with other schemes, gray level co-occurrence matrix automatically reduces the time for contraction of an image while changing it from Red green blue image to image of gray level.

Step4 Using ANN categorization of lung nodules:- During categorization about projected Computer Aided Diagnosis system, cancer is categorized like malignant or else benign. For classification of problems ANN is one of most preferred method. So, for categorization as malignant as well as benign nodules of lung ANN has been used. ANN corresponds to neurons which are interconnected as well as a connectionist is used to process the data.

4.1 Malignant:- This type of tumor results in cancer as the cells through which they build up increases very fast. At times this type of tumor shifts from their actual position to other organs of body where the cancer grows persistently and forms tumor at that particular place.

4.2 Benign:- This type of tumor does not attack on or else reach other organs of body. If cured at time this type of tumor cannot be cancerous. A tumor is an abnormal growth of cells that serves no purpose. A benign tumor is not a malignant tumor, which is cancer.

Experimental Results And Sensitivity Analysis

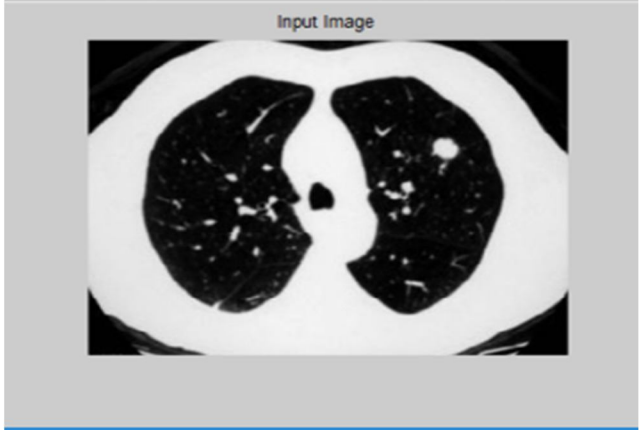

Fig.2 shows the Original image

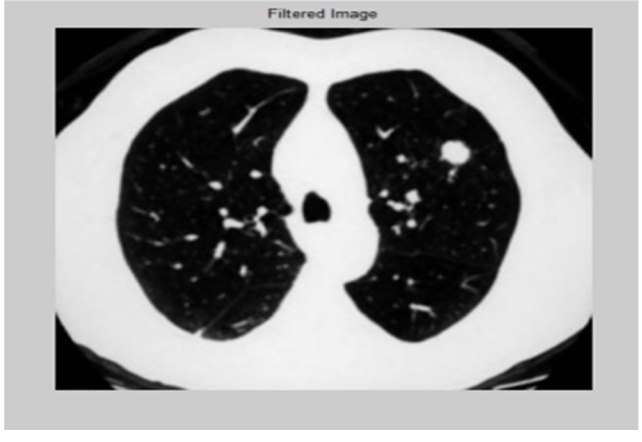

Fig.3 shows Enhancement image

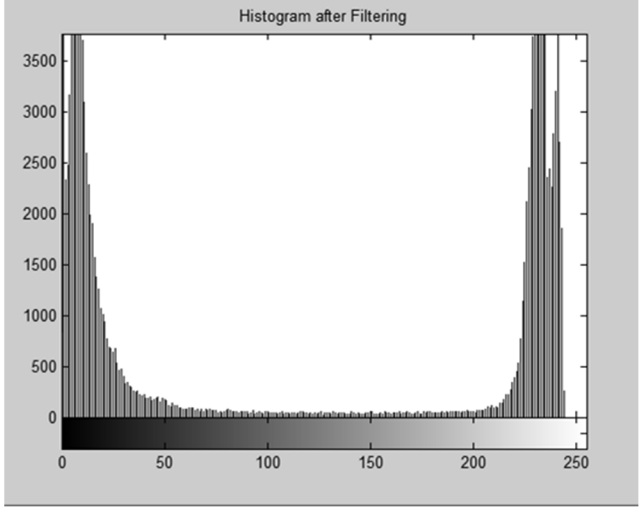

Fig.4 shows Histogram of pre-processed image

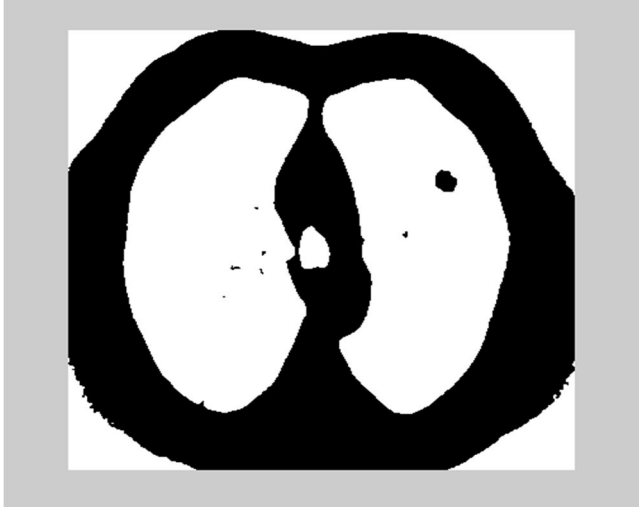

Fig.5 shows Binary image

Fig.6 shows Lung Nodule image

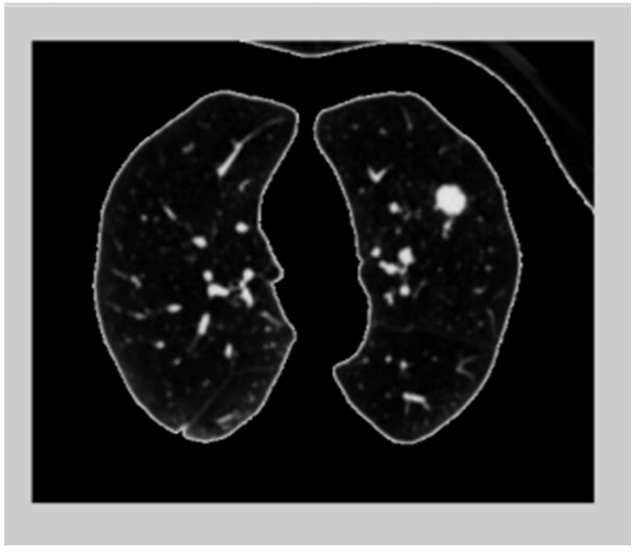

Fig.7 shows Areaopen image

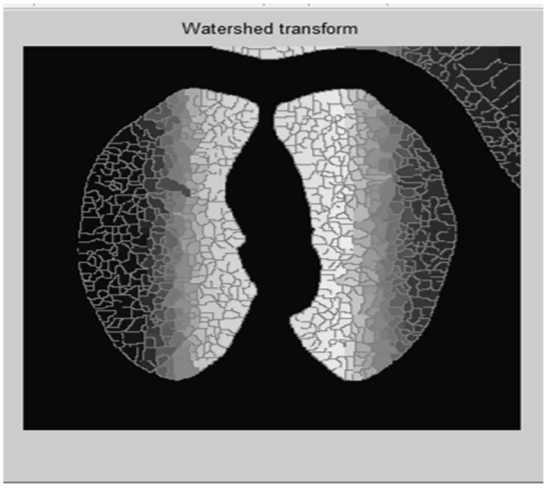

Fig.8 Lung Nodule segmented with Watershed transformation

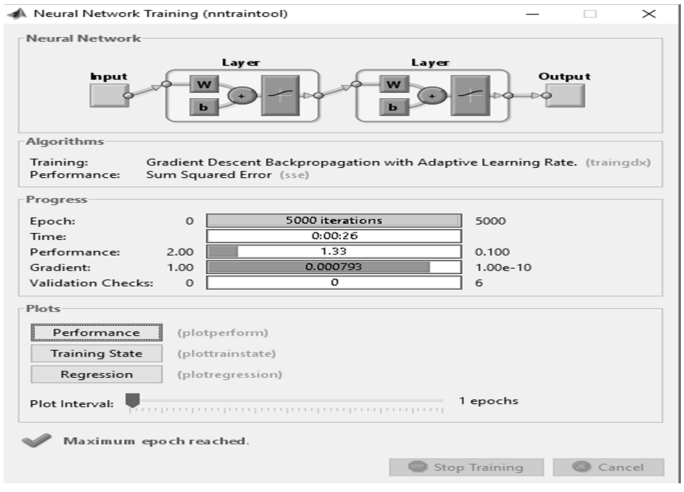

Fig.9 shows ANN training

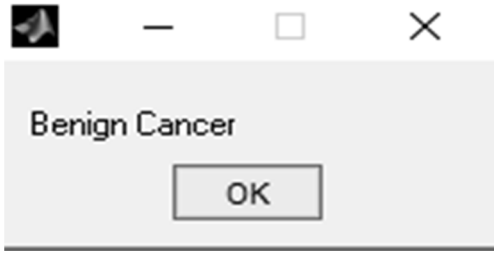

Fig.10 shows Output image

Software that has been used for implementation assessment about projected Computer Aided Diagnosis scheme is MATLAB. The Figures show images of Computed Tomography of the proposed system as the outputs of practices followed. Fig.2 shows initial images of lung, Fig.3 shows the enhanced image and Fig.4 displays histogram of the pre-processed image Fig.5 shows binary image, Fig.6 shows lung nodule image, Fig.7 shows areaopen image Fig.8 shows nodules of lung that are segmented using Watershed Transform approach. Through this approach the region that contains cancer is obtained. Fig.9 shows ANN training, Fig.10 shows output image.

Table I. Results Obtained

Scheme	Positives	Negatives
Malignant	14	1
Benign	1	6

In total 22 images were taken out. 6 out of 7 images were recognized as nodules having benign, only 1 is misclassified as malignant. On the other hand 14 out of 15 images were recognized as nodules having malignant, only 1 is misclassified as benign.
TP=14, TN=6, FP=1, FN=1

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + TN + FP} = 90\%$$

$$\text{Sensitivity} = \frac{TP}{TP + FN} = 93.3\%$$

Table II. Assessment Criterion

Implementation criterion	Results
Accuracy	90
Sensitivity	93.3

Table III presents proposed Computer Aided Diagnosis scheme comparison among other Computer Aided Diagnosis schemes. Diverse Computer Aided Diagnosis schemes are able to show acceptable values of sensitivity in detection of nodules of lung. The method that has been proposed presents higher sensitivity when compared among all other systems.

Table III. Comparison of Performances among Computer Diagnosis systems On the basis of sensitivity

Computer Aided Diagnosis system	Percentage of Sensitivity
Youngbumee	72.0
Opfer and Wiemker	74.0
Suzuki et al.	80.3
Kuruvilla et al.	91.1
Proposed method	93.3

Table IV. On the basis of accuracy

Computer Aided Diagnosis system	Percentage of Accuracy
Sharma and Jindal	80.0
Kumar and Saini	80.0
Shanker and Prabakaran	83.0
Vijaya et al.	84.0
Proposed method	90.0

Conclusion

It has been concluded that, the proposed Computer Aided Diagnosis scheme uses images of Computed Tomography to effectively distinguish the nodules of lung like malignant or else benign. This projected method also reduces the mortality rate. Various steps have been included in the projected CAD system such as pre-processing, lung nodule segmentation, extraction of features and then their classification. For pre-processing image processing commands has been used. Watershed Transformation scheme incorporated within the Computer Aided Diagnosis scheme for early detection about nodules of lung. During classification Artificial Neural Network has been chosen to attain accuracy of higher rates. With the use of existing techniques another types of cancer can also be detected.

Future Scope

- More enhancements in radiologic techniques may possibly generate more exact diagnostic information
- Complementing predictable studies with molecular diagnostics may possibly have a greater impact on patient supervision
- At present processing of an image is done on images of grayscale further improvement can be done directly on colored images
- In order to classify medicinal data more accurately combinations of existing features can be used
- In order to increase survival rate of patients ANT COLONY in the combination with NEURAL NETWORK can be put on implementation

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