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Detection Of Lung Cancer Nodule Using Digital Image Processing

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Abstract

Lung nodule detection and segmentation is impor- tant for clinical diagnosis. Characteristics of pneumonic nodules always indicate the nature of lung disease. This paper uses CT images for the lung nodule detection and segmentation.The identification stage includes pattern matching and confirmation to increase accuracy, performed by otsus algorithm, support vector machine, segmentation. The categorization stage includes matching characteristics (like texture, shape and density) of the detected nodules. Firstly, lung CT images are put through otsus algorithm for nodule detection. Secondly, lung nodules are de- tected inside the lung area using image processing techniques.And finally segmentation is applied to highlight the characteristics.

Index Terms*—Lung Nodule,Otsus algorithm, Computerised Tomography(CT),Detection, Segmentation*

I. INTRODUCTION

Lung cancer has the highest mortality of cancer.Lung Can- cer is one of the most deadly cancer and global disease.Cancer leads to immoderate multiplication of abnormal cells and they affect other tissues too.Two main types of cancer are small cell Lung cancer and non-small Lung cancer.When the nodule grows bigger in size then there's higher chance of cancer And because of it the other body organs may also get affected like brain,bones,liver. In addition eating tobacco, smoking can cause lung cancer.The most common cancers that occur in human beings are: Skin Cancer, Kidney Cancer, Lung Cancer, Bladder Cancer, Breast Cancer, Pancreatic Cancer, Prostate Cancer, Melanoma, Skin Thyroid Cancer etc. Method that deals with image processing of chest Computerized tomog- raphy (CT) scans for early detection of such doubtful nodules in the lung tissue that may provide a clue for lung cancer detection is been proposed.Detection of lung cancer at early stage is important as it can increase survival chances of the patient with early detection.As compared top other cancers, the survival rate of lung cancer is low.One of the major factor behind this is time.Complications can be reduced with early detection as well as survival rate can be increased.The Right Lung is Bigger in size then the left one.

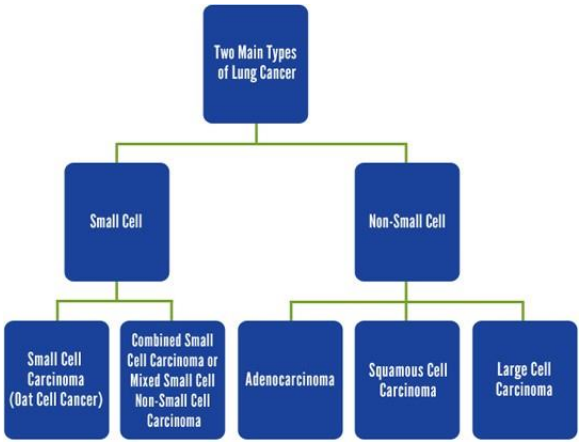

Fig. 1. types of Lung cancer

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II. LITERATURE REVIEW

A. Deep Neural Network

G. Jakimovski proposed a system by using CT images along with Deep Neural Network to help with image dignostics by training the DNN to recognize the cancer. Few other derive methods used, such as, template matching, Support Vector Machine, Deep Restricted Boltzmann, Stacked Autoencoders and Deep Convolutional Networks. Image recognition Is based on image classification in DNN. The neural network is trained so that it can be used for image classification. Process takes input data (large scale CT images), fed to network and output is compared to expected output.

Advantages

Deep Neural Network includes layers of convolution that can efficiently search for anomalies (Cancer), hence will detect possibility of a cancer.

B. Detecion Based on 3D CNN

Lei Fan proposed a system which used 3D CNN architecture on segmented images for feature extraction. The 3D CNN is built upon a 3D convolutional autoencoder. When the convolution of the network used in the identification of CT image, in order to capture multiple consecutive frames, they propose a 3D convolution in the CNN convolution stage to compute the 3D space features. 3D ConvNet is well-suited for spatiotemporal feature learning.

Advantages

Since deep learning is applied to medical images, 3D CNN are effective in the detection of lung cancer.

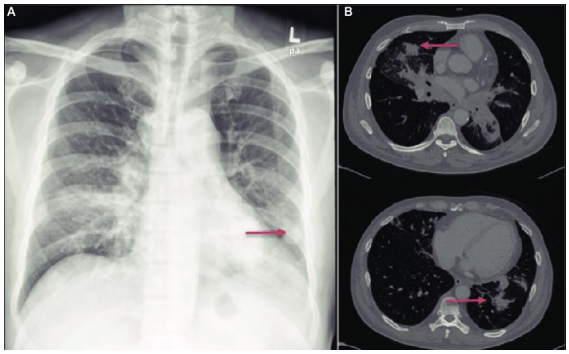
C. Watershed Segmentation

Ilya Levner [1] has presented an approach for creation of topographical function and object markers used in watershed segmentation. Two main key operations in computer vision are pixel grouping and segmentation. With different image segmentation algorithms, when objects of the same predefined class are in close proximity to one another, pixel grouping is necessary to cluster the classified pixels into objects. The wa- tershed algorithm is commonly used within the unsupervised setting of segmenting an image into a set of non-overlapping regions.

D. Thresholding

Feature extraction is an essential stage and it represents the final results to determine the abnormality or normality of an image[1]. These features are the basis for classification process. Ginneken [2] has classified lung regions extraction approaches into two categories; either pipxel or rule based classification based category. Maximum of the proposed ap- proaches are belong to rule-based category [4-5], where it includes sequence of steps, tests and rules in the extraction process. Techniques used are thresholding, region growing, edge detection, and ridge detection, morphological operations, fitting of geometrical models or functions and dynamic pro- gramming.

Fig. 2. Lung Nodule



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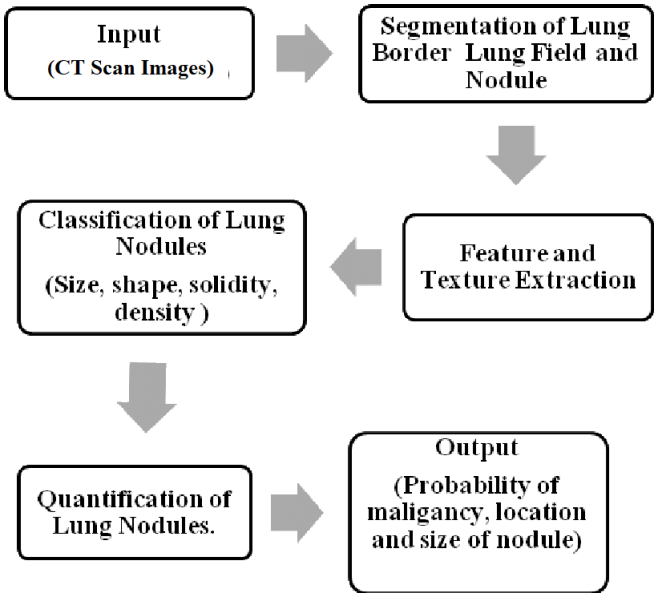
III. PROPOSED SYSYTEM

A new automatic system has been proposed based on image processing algorithms and black circular neighbour algorithm to extract and specify the nodules. Feature exraction is ba- sic important step in algorithms. Feature Extraction seperate which is to be analyzed for further detection of nodules for diagnosis of the disease. Effective mapping is allowed by CT (Computed Tomography) , which decreases the time complexity. GLCM features helps in detection of the nodule, where the Otsus algorithm helps in detection of characteristics of nodules like size, shape and shape of tumour.

Fig. 3. Flow Diagram



A. Image Preprocessing

Apply Image Processing on input CT images(Open CV images)

a. By using Gradient Magnitude we measure the intensity change in the image to find the difference between actual nodule and other objects.

b. Next we apply Warshall's algorithm for image segmen- tation and to separate the object present in CT images other than nodule.

c. Gray Threading will help in characterising the image using the intensity values of pixels. Here it uses Otsu's algorithm to carry out this operation that checks intensity and brightness of each pixel from the image to find hight value characteristics that are similar to given height values.

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B. Erosion and Dilation

In the process of image segmentation , the pixels are allocated according to categories to values ranging accordingly in which a pixel lies. The task of Erosion is to remove the objects which are smaller in size than the size value of a nodule. Next it reconstructs the remaining image object after removing the unnecessary objects in the image. After Erosion , Dilation removes the small holes present in the image produced from large objects in the image.

C. Object Segmentation

In the process of segmentation regional maxima is applied to the image pixels, these pixels are categorized based on their intensity values. This segmentation detects or computes the pixel belonging to same figure or object and then seperate this image from foreground with the object as well as background segmented with each other. The necessary step is the one which derives actual differentiation between the real image and nodule present in it.

D. Nodule Detection

Once we segmented the required portion of image from actual image, we can detect the number of present circles with their specific ratios that classifies the nodules in the CT image.

E. Feature Extraction

From detected Lung Nodules in CT images, following GLCM features will be extracted:

a. Contrast

b. Entropy

c. Correlation

d. Homogeneity

IV. ALGORITHMS USED

A. KNN

a. KNN is a type of feed forward artificial neural network in machine learning in which the connectivity pattern between neurons is compared with organization similar to animal visual cortex. Where individual neurons neurons are present or kept in such a way that they respond to the overlapping region that is lining the visual field.

b. KNN algorithm was inspired by a Biological process and hence it is variation of multi layer perceptions that are de- signed to implement minimal amount usage of preprocessing.

1) KNN classifier is particularly suitable to use when there's the local features which describe the image are classified from image. *Initialization:* Xavier initialization is used in order to achieve convergence, With this the gradients and activation's are maintained in a moderate controlled levels. Without this the propagated gradients might get destroyed or they might explode.

2) *Activation Function:* it is responsible for transforming the data into a non-linear format, where the Linear Rectifier units are defined as (Rel, U)

$$f(x) = max(0, x) \quad (1)$$

where it concludes that we found better results than the normal classical function or hyperbolic tangent

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functions. And in addition it speeds up the training process. However, on imposing a constant counter 0 impairs the gradient flow and consequent adjustment of the weights. Hence these limitations here are overcome by coping using a variant called Leaky rectifier linear unit (LReLU) which introduces a small slope specifically on the negative portion of the function , and this function is defined as,

$$f(x) = max(0,x) + min(0,x) \quad (2)$$

3)

B. Otsu's Algorithm

The expression can be given as:

$$[M^2w(t) = q1(t)M1^2(t) + q2(t)M2^2(t) \quad (3)$$

where variable 't' is threshold, q1 and q2 are probablity functions and M is the class variance.

1) 4) *Image thresholding algorithm*

The need of implementation of thresholding is to choose an intensity value for threshold level and the values below this threshold are converted to 0 (black) , similarly the vakues above this threshold are coverted to 1 (white). If T is global threshold of given image f(x,y) where g(x,y) is the threshold image ,then:

$$[g(x,y) = 1, iff(x,y) >= T \quad (4)$$

Fig. 4. Image before and after thresholding

V. RESULTS

Following table gives the accuracy of normal and abnormal images:
Accuracy can be calculated as percentage ratio of TRUE POSITIVE to Total number of images

	IMAGES	ACCURACY
1.	Normal Images	91.35
2.	Abnormal Images	85.16

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GUI

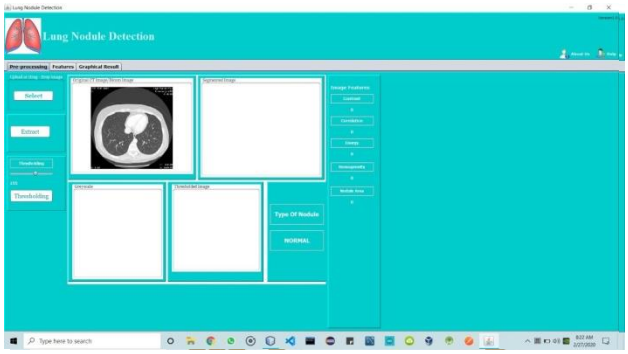

Fig. 5. Initial Image

Fig. 6. Gray scale and Threshold imge

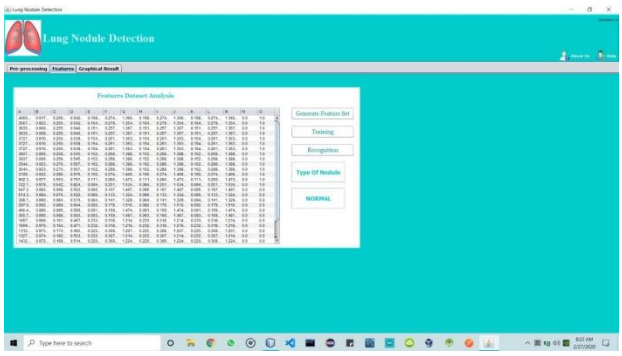

Fig. 7. SVM feature dataset

Advantages

This whole system can be implemented with a very efficent low cost.

CONCLUSION

It is a robust and new method for detection of pulmonary lung nodules in CT images. Where initially the input images are prepossessed and remaining thing to do is to adjust the contrast levels of the images Next the segmentation is carried out and the present nodules are identified. In feature extraction process, features are extracted from the identified nodules and then given as input to KNN for classification. In this stage of process the abnormal and normal images are classified using KNN algorithm and further the accuracy is calculated.

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