

Lung cancer detection using medical images through image Processing

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ABSTRACT

This paper deals with formation of a lung cancer detection system. The system formed can take any type of medical image within the two choices consisting of CT and MRI images. Here the proposed model is developed using the various techniques of image processing. Super pixel Segmentation has been used for segmentation and Gabor filter is used for De noising the medical images. Simulation results are obtained for the cancer detection system using MATLAB and comparison is done between the two medical images.

KEY WORDS: Superpixel Segmentation, Image processing, Morphological processing, Dilation, Erosion.

1. INTRODUCTION

Many deaths are caused due to lung cancer worldwide and it has become very prevalent in recent years. Cells constitute a human body, frequently dividing to make a tissue. Generation of tumour is a process in which a cell's division starts uncontrollably outside of the orders in the lungs. Lung cancer is a type of tumour which gets bigger in size and enters to other organs of body. Non-small cell lung cancer (NSCLC) and small cell lung cancer (SCLC) are the two main types of lung cancer. As non-small cell lung cancer is a more common type of lung cancer, this paper is based on the detection of non-small cell lung cancer. There's a difference between the diagnosis and treatment of non-small cell and small cell lung cancer. There are various ways to detect lung cancer by using Computed Tomography (CT) scan image, Magnetic Resonance Imaging (MRI) scan image, Ultrasound image. Image processing of necessary part of the lungs is used for early diagnosis. For this, a system is developed which will help the doctors to easily detect cancer in lungs from any one of the two images given as input and gives proper analysis. In this paper, CT scan image and MRI scan image are used. A CT scan or Computerized Axial Tomography (CAT) scan produces cross-sectional images of specific areas of scanned object by the use of computer processed combination of many X-ray images taken from different angle. An MRI or Nuclear Magnetic Resonance Imaging (NMRI) is an imaging technique which uses radio waves and magnetic field to form images of body. The aim of this paper is to design a system which can take any one of the two images and produces an output. The Super pixel segmentation algorithm is a powerful algorithm in terms of sensitivity, specificity and accuracy. The proposed model consists of following steps such as: Collection of lung image data set, preprocessing, edge detection, morphological processing and segmentation of CT and MRI images. Every step is described in further sections.

2. METHODOLOGY

In this section, the methods acclimated for the proposed archetypal is described. From this, the best adjustment which can ascertain blight and abstract blight tissue advice from the two images is found. The steps to classification of lung cancer are given in the Fig.1.

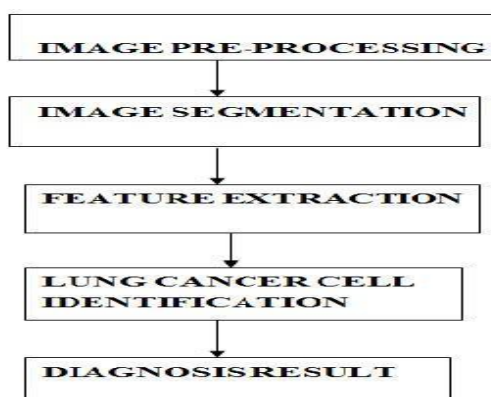


Fig.1.Lung Cancer detection system flowchart

The data used for this paper includes 6 CT and 15 MRI scan images of lungs. The lung's images have a dimension of 512 x 512.

a) Image pre-processing: Image pre-processing is used to reduce noise and prepare the images for further steps such as segmentation. It diminishes baloney in angel and enhances the accordant features. Thus a rectified angel is

obtained. For this purpose, MATLAB software has been used. The assorted accomplish complex in angel processing are smoothing, angel enhancement, blooming band break and gray akin conversion.

b) Image enhancement: The various image enhancement techniques can be categorized as spatial domain methods and Frequency domain methods. Different image enhancement techniques are used for all the different images. This includes smoothing of image and removal of noises, blurring etc. Gabor filter was found to be suitable for both the CT and MRI images. The filtering of image proves to be useful for further steps.

c) Layer separation: An image is formed of pixels. Each pixel consists of RGB values. In this paper, layer separation is used to eliminate the effect of other two colors i.e. red and blue and represent the image in green color. It reduces the complexity for proper conversion to gray level.

d) Gray conversion: This includes conversion of colored image with pixels having RGB level into Gray level. A Gray level image can be easily processed in comparison to colored image. The reason is the pixels to be processed separately which have different RGB values. Therefore Gray conversion is preferred.

Lung Region Extraction:

a) Super pixel Segmentation: To analyze an image it is necessary to separate the objects or regions of interest from the other parts of the image. There are different techniques used for performing segmentation depending upon the specific application, imaging modality and other factors etc. For instance based on the usefulness in a particular application the image pixels are classified into anatomical regions, such as muscles, bones and blood vessels or into pathological regions, such as tissue deformities, multiple sclerosis lesions and cancer. Here segmentation of lung region in two type of images has been performed to achieve a better orientation in the image. It initiates with the image slicing algorithm used for each of the image of raw data. The best image is chosen from the resulting binary images. This helps in extracting the lung region with certain degree of accuracy and sharpness. For further improvement of chosen image features, other techniques can be used for different utilization in a sequence of steps.

Median filter, Erosion and dilation steps eliminate irrelevant details that may enhance difficulties to the lung border extraction process. The aim of the outlining border is to extract the structure's border called as lung border extraction. It is helpful in eliminating useless structures from lungs.

b) Segmenting Extracted Lung Nodule: Proper analysis of an image can be done after segmentation as it makes the image more meaningful and easier to analyze. It can be used to clear cut the boundaries (lines, curves etc.) and objects in image. More precisely, image segmentation is the process of assigning a label to the pixels with the same visual characteristics in an image. The result of image segmentation is a set of segments that collectively cover the entire image or a set of contours obtained from the image (edge detection).

There is a similarity between the pixels in a given region in the context of some computed property like color, intensity, or texture. The neighbourhood lying regions may differ with respect to some characteristic(s).

This has been done using edge detection and the steps for it are: a) An Edge is a set of allied pixels that lie on the boundary between two regions, b) Edges are detected by Canny method, c) Canny method is chosen because of its Accuracy.

c) Feature Extraction: The Image feature extraction stage is an essential step that represents the final output and determines the normality and abnormality of an image using algorithms and techniques. In image processing these algorithms and techniques detect and eliminate various non-desirable portions or shapes (features) present in an image. Initially segmentation is performed on lung region followed by steps of feature extraction to obtain its features. At last in accordance with some diagnosis rule the cancer nodules can easily be detected in the lungs. These diagnosis rules can eliminate the false detection of cancer nodules resulted through segmentation and provide better diagnosis. In the literature it was found among the features used in the diagnostic indicators, a) Shape, b) Area of interest, c) Size of nodule and, d) Contrast Enhancement, e) Calcification.

Similarly, to achieve accurate diagnosis we experimentally found the above suitable texture features. As a matter of fact, the first feature (the area of the candidate region or object) is used for: a) Elimination of very small candidate object (Area is less than a thresholding value), b) Elimination of isolated pixels (seen as noise in the segmented image).

The elimination of the extra candidate regions that probably will not form a nodule can be achieved by the use of necessary feature ; furthermore it's utilization helps in minimizing the computation time required in the upcoming diagnostic steps. The 2nd feature is calcification in which we discover that Diffuse, central, laminated or popcorn calcifications are benign patterns of calcification.

The above cited calcification is spotted in hematomas and granulomatous disease. The other remaining patterns should not be considered as a signal of benignity.

But this rule proves to be a failure in the case of patients known to have a primary tumour. This was evident in patients having osteosarcoma or chondrosarcoma where diffuse calcification pattern was observed. Similarly, central and popcorn pattern was evident in patients who suffered from GI- tumours and previously had chemotherapy.

A polygonal shape as well as a three-dimensional ratio > 1.78 and a peripheral sub pleural location were proved to be a sign of benignity through the screening. Studies carried out in Shape Japanese. This is the 3rd feature. A polygonal shape is a lesion having multiple facets.

Maximal Transverse dimension divided by maximal vertical dimension gives three dimensional ratio. A large three-dimensional ratio shows that the lesion is proportionately flat, which is a benign sign. A single intraparenchymal lesion less than 3 cm in size and not associated with atelectasis or lymphadenopathy is known as a solitary pulmonary nodule (SPN) which is the 4th feature. Mass is basically a nodule which is greater than 3 cm in diameter.

As lesions greater than 3 cm are usually malignant, while smaller lesions can be either benign or malignant therefore this analysis/ distinction is made. Swensen, observed the relationship between the size of a SPN and the chance of malignancy in a cohort at high risk for lung cancer. For smaller lesions the conclusion was that benign nodule detection rate is high. Of the over 2000 nodules that were less than 4 mm in size, none was malignant.

Contrast Enhancement taken provides the results that less than 15 HU possess a very high predictive value for benignity (99%). This is the 5th feature.

After a baseline scan, 4 consecutive scans are performed at an interval of 1 minute after a baseline scan.

This applies only for nodules with the following selection criteria:

- a) Relatively spherical,
- b) Nodule $> 5\text{mm}$,
- c) Homogeneous, no necrosis, fat or calcification.

3. RESULTS AND DISCUSSION

In this paper Lung CT and MRI images used were obtained from a specialist medical imaging centre. The image enhancement is done using Gabor filter. After enhancement step, the images were passed from layer separation step and then converted to Gray level image. For segmentation Super pixel segmentation algorithm was used thus lung region or (ROI) is extracted. The steps applied on CT and MRI images are shown in Fig.1 and Fig.2 respectively.



Fig.1. Segmentation steps for CT Image a) input denoised image, b) green layer separation, c) gray level intensity, d) edge detection, e) morphological processing f) segmentation, g) superpixel segmentation

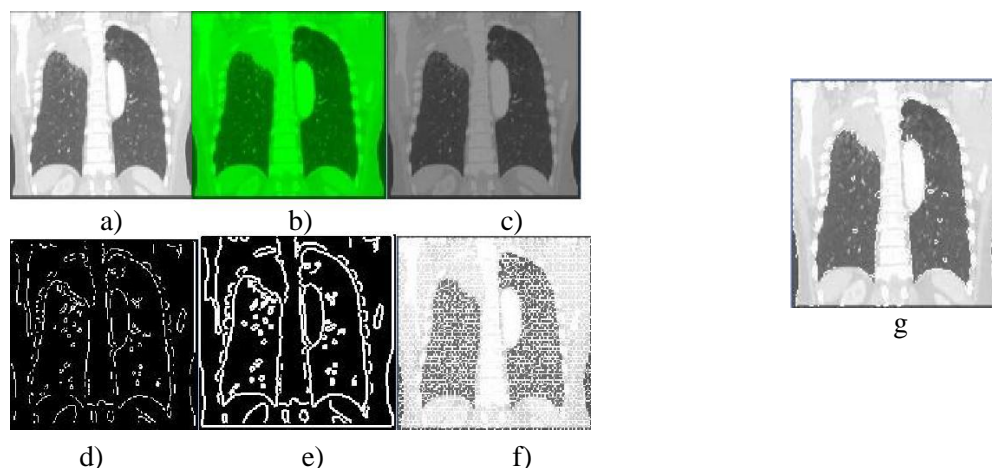


Fig.2. Segmentation steps for MRI Image a) input denoised image, b) green layer separation, c) gray level intensity, d) edge detection, e) morphological processing, f) segmentation, g) superpixel segmentation

4. CONCLUSION

In this survey of cancer detection in MRI and CT images, we have studied the major image modalities through image processing. We proposed a method for segmentation of both MRI and CT images. To correctly identify the cancer cell, necessary features are extracted and studied for the two images. In future we can use Ultrasound images as well to detect the validity of this system.

Future Scope: By the process used complexity is reduced and diagnosis confidence is improved. We have used

Gabor filter for noise reduction for the two images. Canny filter is used for edge detection and finally we go for super pixel segmentation. Further we can do the classification through Pearsons and Spearman algorithm to detect the cancer prone region in all the three images.

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