LUNG NODULE SEGMENTATION IN COMPUTED TOMOGRAPHY IMAGE

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ABSTRACT: The key process to detect the Lung cancer is the critical observation on the CT scan images where the visual inspection carefully analysis the geometrical features of blob shaped objects found inside the lung region. This traditional approach becomes tedious for the clinical experts when analyzing large amount of CT images and courses to introduce error in the prediction of the cancer nodules. Further the detection of blobs touching the inner wall of the chest is very challenging task and most of the proposed methods are time consuming due to the complex architecture of the algorithms. Therefore, in this paper a computer vision solution is proposed to automatically localize the lung nodules and to overcome the difficulties found in the earlier methods. Experimentation is conducted on CT scan data and shows promising results in the localization of the lung nodules.

Keywords: h-maxima, CT image, Nodule, Segmentation.

1. INTRODUCTION

The world is suffering from the cancer disease affect the various human body regions in male and female and among that the lung cancer is one of the most dangerous diseases. Further the lung cancer can be diagnosed by detecting the lung cancer nodules in the early stage. Invent of CT scanners produces huge amount of data in 3D space and different orientation. These images are visually analysed by the clinical experts to localize the potential blob shaped objects those are the candidates for the lung cancers. However this manual task is very time consuming and incur errors in the prediction. Hence, development of an automated computer vision system is becoming as an essential tool to detect the cancer nodules in the CT scan images.

Due to the importance of the automatic detection of nodules and challenges in the automatic localization of nodules, there are large amount of research work have been conducted in the past years. Every researcher introduces new methodologies to improve the accuracy rate by addressing the challenges. While the methods are focusing on the accuracy rate, it drastically increases the computation time. Further the detection of blobs near to the wall is still a challenging task and more researchers and competitions are initiated to develop automatic system that addressing the various issues and reducing the computation time.

In this research work, a computer vision approach is proposed to segment the blob shaped objects with the help of peak detection and this method will overcome the challenges in the detection of touching blobs. Detail description of the proposed method and testing results are given below.

2. OVERVIEW OF THE PRPOSED METHODOLOGY

The proposed method is a computer vision approach where intensity enhancement and morphological methods are incorporated to segment the nodules in CT scan image. Visual inspection on the CT scan shows that the nodules are brighter region and surrounded by the gray intensities as shown in Figure 1. Hence these blobs can be segmented using threshold based approaches. However it may be affected by the touching blobs near the wall of the chest.

The overview of the proposed method is shown in Figure 2 and segments the nodules by enhancing the nodule intensity and finds the peek area as a possible location of the nodule.

Hence the proposed method initially employees the Top-hat transformation to locally enhance the nodule intensity from the background by eliminating the uneven intensities and background noise. This process will provide clear contrast between two nearby objects and useful to segment the touching blobs.

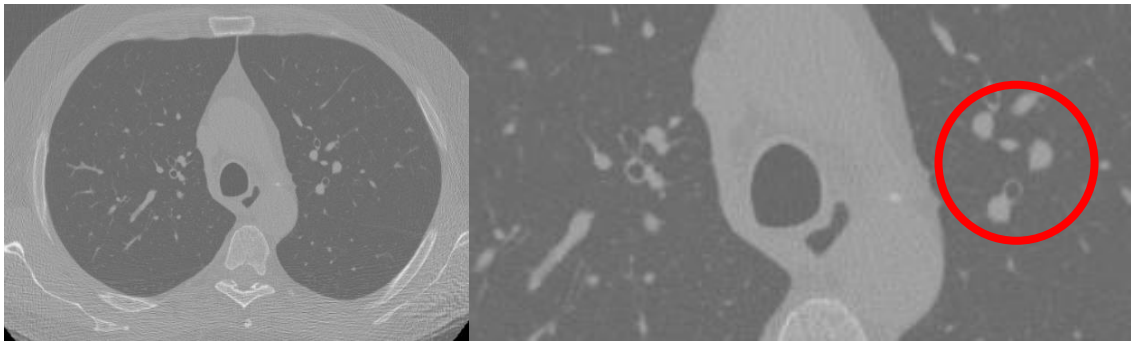

Figure 1. A CT scan image of the lung region. The circle region in the zoomed image (right): a brighter blob shape particles have higher intensity than the surrounding region.

Top-hat transformed image (I_{top}) is defined mathematically as follows:

$$I_{top} = I - I * S(r)$$

where I is the original image and S is the circular structure elements with radius r and the value for r is set according the size of the blob (nodule). In $I * S(r)$, * denotes the convolution operation.

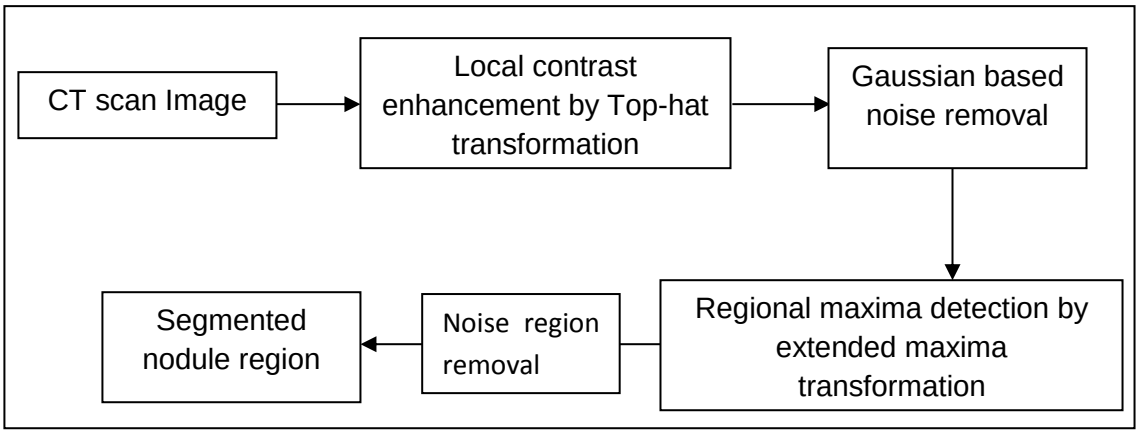

Figure 2. Overview of the proposed lung nodule detection framework.

The original image and the top-hat transformed image are shown in Figure 3. It clearly indicate the contrast between the background and the internal structure of the lung. However it is affected by noise and removed by applying the Gaussian based smoothing mechanism and shown in Figure 3.

After smoothing, the regional maximum is detected using the extended maxima transform where the height value is decided based on the size of the blob (nodule). Further the identified noisy regions are removed by applying morphological operators such as erode and dilation where the erode operation is followed by the dilation operation, hence the smaller regions are remove and the region of interest is enlarged. More qualitative details are given in the results and discussion section.

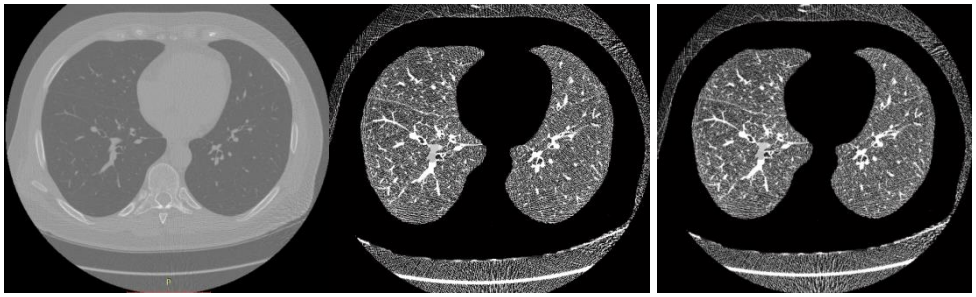

Figure 3. Original (left) and top-hat transformed (middle) image and Gaussian smoothed image (right)

3. RESULT AND DISCUSSION

The experimentation was done using the publically available lung CT scan data sets and the program was written in Matlab.

Data set: The data set was downloaded from the publically available repository at https://veet.via.cornell.edu/lungdb.html.

The results shown in Figure 4 clearly indicate that the proposed methods can able to detect the nodules using the regional maxima detection. The results are very promising. More results are shown to prove the detection ability of the proposed methodology in Figure 5.

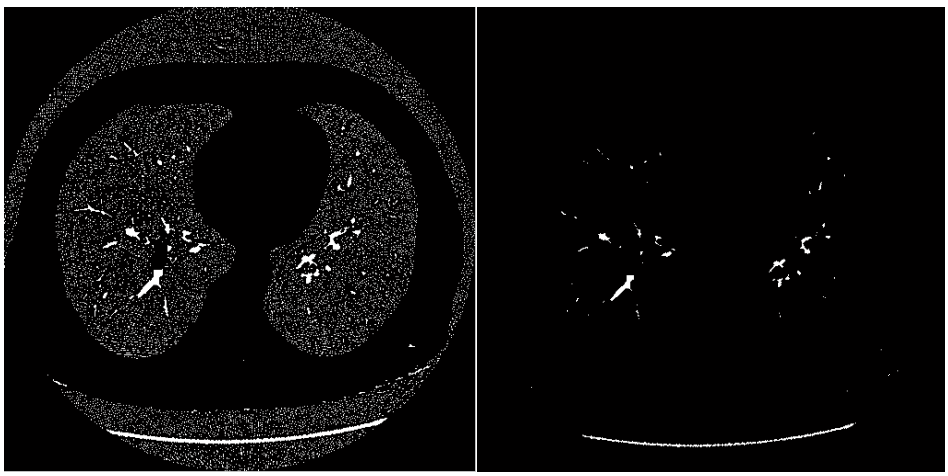

Figure 4. The results obtained by applying the extended maximum transformation and morphological operation. On left, the extended maximum transformation and identified possible nodule shown on right.

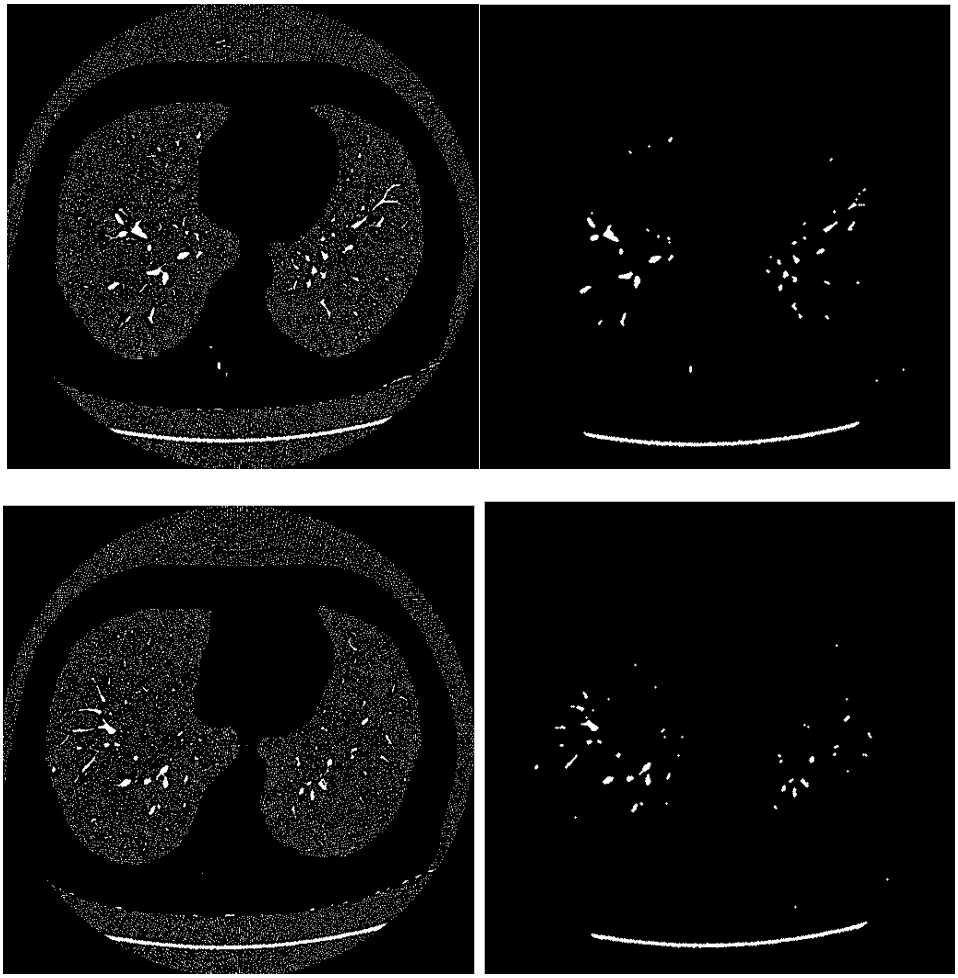

Figure 5. Some more results from the lung CT scan images. Extended maximum transformation and the identified possible region of interest are shown.

4. CONCLUSION

A maxima detection based method is proposed and tested on CT scan dataset and the results show promising to identify possible markers for the lung nodules. It should be further analysed to classify the cancer nodules and the normal structure of the lung. This is our future objective and testing on more data sets. The results are not quantitatively analysed and in future we will contact medical experts and perform the quantitative analysis. As a conclusion, this a preliminary research to detect the lung nodules and successfully detected the possible region of interest for lung nodules.

5. REFERENCES

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