DEMARCATION OF LUNG LOBES IN CT SCAN IMAGES FOR LUNG CANCER DETECTION USING WATERSHED SEGMENTATION

Siti Noraini Sulaiman[1*], Nur Najihah Sofea Mohd Marzuki[1], Noor Khairiah A. Karim[2], Iza Sazanita Isa[1], Mohd Firdaus Abdullah[1] and Ibrahim Lutfi Shuaib[2]

[1]*Faculty of Electrical Engineering, Universiti Teknologi MARA, Cawangan Pulau Pinang, 13500 Pulau Pinang, MALAYSIA*

**E-mail: sitinoraini@uitm.edu.my*

[2]*Regenerative Medicine Cluster, Advanced Medical and Dental Institute, Universiti Sains Malaysia, Bertam, 13200, Kepala Batas, Penang, MALAYSIA*

ABSTRACT

Lung cancer is one of the dangerous and life-threatening cancer diseases in the world. The most common ways to detect lung cancer is by using the Computed Tomography (CT) image. Nowadays, Computed Aided Diagnosis (CAD) is becoming more prominent. In medical applications, the CAD system is adopted to help doctors to perform an image analysis and make their final decisions. Therefore, the main aim of this research is to establish an image processing method for the segmentation of lung cancer from CT scan images. To achieve the main aims, the work is divided into two parts, first is obtaining the lung region from CT scan images and second is detecting the lesion of lung cancer. This paper will present the outcome of the first part. Firstly, the image will undergo the threshold, clustering, and image filtering as well as the enhancement process to get better and clearer lung area images. Next, is the segmentation stage where modified watershed is used to demarcate the lung region from the CT scan images. The outcome of this research is very helpful for the doctor to determine later the type of treatment that should be provided to the patient.

Keywords: lung cancer, Image segmentation, watershed segmentation, CT scan image

1. PROPOSED METHOD

In this study, the proposed system is divided into 4 phases i) data/image acquisition ii) image pre-processing iii) image segmentation and iv) evaluation. There are many pre-processing techniques proposed, which can be used in different conditions. A proper pre-processing technique is important so that the quality of image produced is preserved. The aim for the pre-processing stage is to improve the contrast and clarity of the image as well as to separate the background noise. Therefore, there are many techniques such as smoothing, and a few enhancement techniques including the image segmentation technique are applied to the image to improve the quality of image in this pre-processing stage. The table gantry, subcutaneous tissues, muscle, and bones are the unwanted parts and thus, they need to be removed. Therefore, a removal stage is required in the pre-processing phase to provide a more robust result in the next stage i.e. the contrast enhancement stage. Besides that, these unwanted parts need to be removed to avoid interference on similar intensity information on the lung area during the detection phase. Figure 1 shows the step-by-step process of the removal of the unwanted parts and the outcome of each step. In this research we propose a modified watershed segmentation model. In the segmentation lung nodule using the conventional watershed, a preferred result cannot be directly obtained. A few modifications need to be done since the conventional is

not effective for the lung nodule segmentation. Figure 2 shows the block diagram of the modified watershed method.

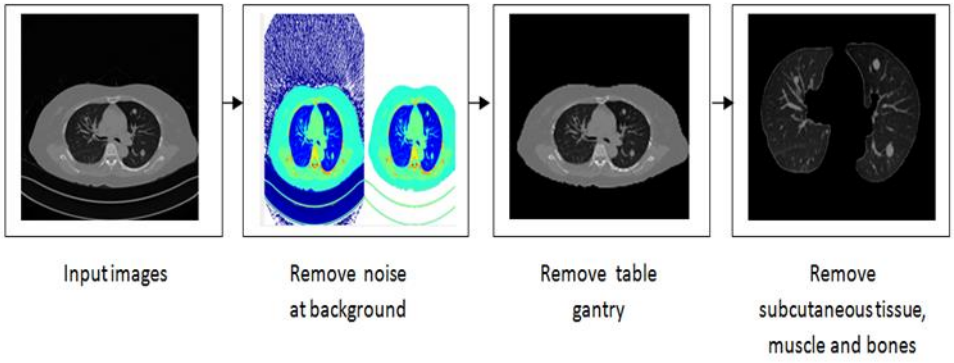


Figure 1. Step-by-step process of unwanted parts' removal in the pre-processing stage

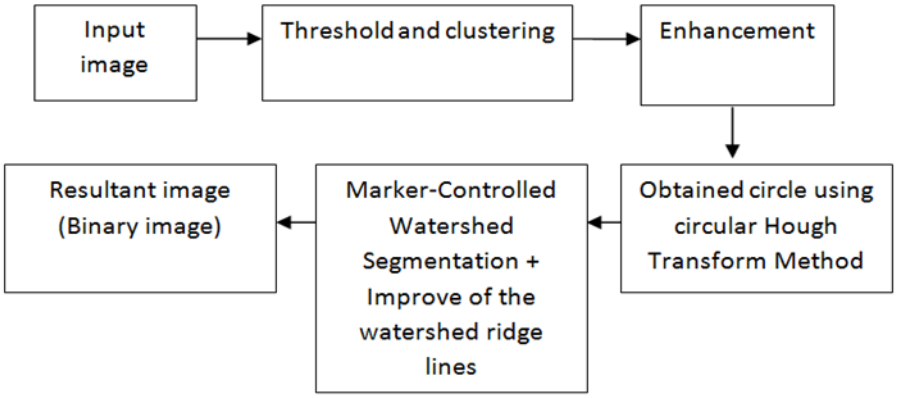
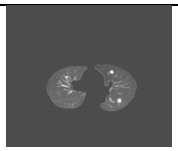
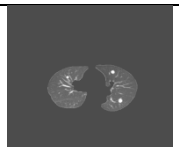
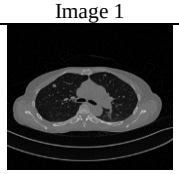
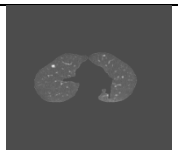
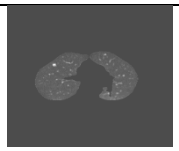


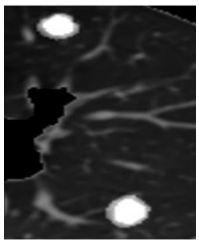
Figure 2. Block diagram of the modified watershed method

2. RESULT AND DISCUSSION

For this article, a total of 2 images of the lung with different shapes of lung area are presented, tested for the proposed modified watershed segmentation. Table 1 shows the outcome of the conventional watershed and the proposed modified watershed detecting the lung area of lung cancer. It can be seen that both methods are able to detect the lung lobes but with the proposed modified watershed method the resultant image is better, the edge is smoother the region between the lung cancer area and the lesion part becoming more enhanced. Figure 3 shows the zoom region to illustrate the smoother edge and better enhanced lesion region of the resultant image obtained by the proposed watershed method, as compared to the conventional watershed. An average performance was tabulated in Table 2 based on the precision, recall, accuracy and F-score. Conventional Watershed segmentation gave an average value of precision 99.83%, recall 97.96%, accuracy 99.64% and F-score 98.87%. The proposed modified Watershed segmentation gave a slightly higher performance where the precision is 99.97%, recall 98.82%, accuracy 99.87% and F-score 99.38%.

Table 1. Detection of Lung Cancer

	Conventional watershed	Proposed Modified watershed
 Image 1		
 Image 2		


(a)

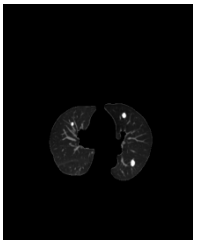

(b)

Figure 3. The resultant image of (a) Conventional watershed (b) proposed modified watershed method

Table 2. Average performance of Image Segmentation Technique

Segmentation	Precision	Recall	Accuracy	F-score
Conventional Watershed	99.83	97.96	99.64	98.87
Proposed Modified Watershed	99.97	98.82	99.87	99.38

3. CONCLUSION

This paper proposes a modified watershed segmentation method for detecting the lung region from CT scan images. It combines the technique of filtering, clustering and segmentation in the pre-processing stage with the proposed modified watershed in the next stage. The proposed method gives a better performance as compared to the conventional watershed with the accuracy of 99.87%. The performance shows that the method used in this first stage is effective and is ready to be used in the second stage i.e. to detect the lesion of lung cancer. The outcome of this work shows that this approach is applicable for object detection with a few modifications. We have demonstrated the effectiveness of the method by a few examples from the CT scan images.

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