Lung Cancer Detection Using Active Contour Segmentation Model

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Abstract* — Lung cancer proves to be a harmful threat to people who are more commonly used in people who smoke. Of 100 different types of cancer observed in the human body, this is the third largest cancer found with less survival rate. Early detection of lung cancer can increase the survival among humans. Various image processing and soft computer techniques can be used to determine cancer cells from medical images. In the traditional method, they use to identify lung cancer using Active Contour Segmentation Model. First, both lungs are segmented by the active contour model for their initialization, a masking technique is used. This mask is partly preserved by our morphological processes after refinement. Through this mask, non-isolated lungs, which are connected to the breast wall, are transmitted into the isolated lungs, which can be easily detected. Then, regions of interest (ROIs) are detected using some stochastic 2D features. In this step, some segmental bronchi or bronchioles (small airways in the lung) could be detected in the ROI. Finally, recognized lungs are used as initial masks of active contour modelling to accurately extract the contours of the lung. In the Novel method, we will use the regional and marker-based watershed Segmentation. The watershed transformation is widely used in many areas of image processing, including medical image segmentation due to the number of advantages it has: it is a simple, intuitive method, it is fast and can be parallelized and produces a complete division of the image In separate areas, even if the contrast is poor, eliminating the need for any kind of contour connection. In addition, several researcher techniques have been proposed to embed the watershed transformation in a multiscale framework, thereby providing the benefits of these representations. The overall performance of the Active Contour Segmentation method is 86%, but we can achieve up to 98% performance of the result can be obtained in our novel Regional and marker based watershed segmentation.

***Keywords*— lung cancer detection, active contour segmentation**

I. INTRODUCTION

Lung cancer is the type of cancer that begins in the lungs. Lung cancer is considered the main cause of cancer death worldwide, and it is difficult to detect early stages because symptoms appear only in the advanced stages causing the mortality to be among the highest among all other types of cancer. More people die because of lung cancer than any other types of cancer such as breast, intestinal and prostate cancer. There is significant evidence that early detection of lung cancer will reduce mortality. Cancer is one of the most serious health problems in the world. The mortality rate of lung cancer is the highest among all other forms of cancer. Lung cancer is one of the most serious cancers in the world, although the survival rate is very low if the diagnosis is made too late so the survival rate gradually drops every year. The survival of lung cancer is directly linked to its growth stage and detection time. The earlier detection will offer the higher chances of living in the world. Several researches are estimated as 85% of lung cancer cases in men and 75% in women are caused by cigarette smoking. In 2010, 42,026 people in the UK were diagnosed with lung cancer and there were 35,184 deaths from lung cancer. The overall survival rate for all types of cancer is 63%. Although surgery, radiation therapy and chemotherapy have been used as the treatment of lung cancer; the five-year survival rate for all stadiums combined only 14%.

Based on the statistics of the American Cancer Society, it is estimated that there are 2, 20,000 new cases, 1, 60,000 deaths a year, and the 5-year survival rate for all stages is only 15%. The various factors that affect the 5-year survival rate are stage cancer, type of cancer, other factors such as symptoms, general health etc. However, the symptoms of lung cancer do not appear until cancer spreads to other areas, resulting in 24% Chances of lung cancer detection in early stages. Thus, it is necessary to have an accurate early detection of lung cancer system to increase the survival rate.

II. REGIONAL AND MARKER BASED WATERSHED SEGMENTATION

Region is a simple regional image segmentation method. It is also classified as a pixel-based image segmentation method, since it includes the selection of initial seed points. This approach for segmentation examines neighbouring pixels from initial start points and determines whether the pixel neighbours are to be added to the region. The process is iterated in the same way as the general data clustering algorithms. The main goal of segmentation is to share a picture in regions. Some segmentation methods such as thresholding achieve this goal by searching the boundaries between regions based on discontinuities in grayscale or color properties. Regional segmentation is a method for the direct determination of the region.

The Watershed transform has interesting properties that make it useful for a much different image segmentation application. Watershed transformation is a powerful tool for image segmentation based on mathematical morphology. A water wave transformation as a means of separating overlapping objects. We can view the image as a landscape or a topographic relief, interpreting the gray level of each pixel as its height in the relief. Immersing the landscape into a lake with holes pierced in local minima begins with water beginning at these local minima. At points where water comes from different basins, dams are built. This process ends when the water reaches the highest point of the landscape. Consequently, the landscape is divided into regions or basins separated by dams, which are called water-cutting or simply water-cutting. The main disadvantage of this method is the over-segmentation due to the presence of many local minima. To reduce the effect of a strong over-segmentation, labelling-controlled water table transformations have been proposed. These are robust and flexible methods for segmenting objects with closed contours. The internal marking and the external marking are defined first. The boundaries, even if not clearly defined, are expressed as ribs between two markers. In the marker-controlled water-cutting process for segmenting the image, the external marking is obtained manually by drawing a circle that encloses an object of our interest. The internal marker is automatically determined by combination techniques, including canny edge detection, thresholding, and morphological operation.

III. LITERATURE REVIEW

A. Registration-Based Lung Mechanical Analysis of Chronic Obstructive Pulmonary Disease (COPD) Using A Supervised Machine Learning Framework.

1) ***Rationale and Objectives:*** *This study evaluated the performance of computed tomography (CT)-derived biomechanical based features of lung function and the presence and severity of chronic obstructive pulmonary disease (COPD). It performed well when compared to CT-derived density and textural features of lung function and the presence and severity of COPD*
2) ***Materials and Methods:*** *A total of 162 subjects (Global Initiative for Chronic Obstructive Lung Disease [GOLD] stages 0-4 and non-smokers) subjects with CT scan performed at total lung capacity or expiration to functional residual capacity were evaluated. CT-derived biomechanical, density, and textural feature sets were compared to forced expiratory volume in 1 second (FEV1) %, FEV1/forced vital capacity, and total St. George's respiratory questionnaire scores. The ability of these feature sets to assess the presence and severity of COPD was also evaluated. Optimal features are selected by linear forward feature selection and the classification is done using k nearest neighbour learning algorithm.*
3) ***Conclusion:*** *This study shows the effectiveness of CT-derived biomechanical measures in the assessment of airflow obstruction and quality of life in subjects with COPD. CT-derived biomechanical features performed well in assessing the presence and severity of COPD.*

B. Computational Modelling Of Electrocardiograms: Repolarisation And T-Wave Polarity In The Human Heart

For more than a century, electrophysiologists, cardiologists and engineers have studied the electrical activity of the human heart to better understand rhythm disorders and possible treatment options. Although the depolarisation sequence of the heart is relatively well characterised, the repolarisation sequence remains a subject of great controversy. Here, we study regional and temporal variations in both depolarisation and repolarisation using a finite element approach. We discretise the governing equations in time using an unconditionally stable implicit Euler backward scheme and in space using a consistently linearized Newton–Raphson-based finite element solver. Through systematic parameter-sensitivity studies, we establish a direct relation between a normal positive T-wave and the non-uniform distribution of the controlling parameter, which we have termed refractoriness. To establish a healthy baseline model, we calibrate the refractoriness using clinically measured action potential durations at different locations in the human heart. We demonstrate the potential of our model by comparing the computationally predicted and clinically measured depolarisation and repolarisation profiles across the left ventricle. The proposed framework allows us to explore how local action potential durations on the microscopic scale translate into global repolarisation sequences on the macroscopic scale. We anticipate that our calibrated human heart model can be widely used to explore cardiac excitation in health and disease. For example, our model can serve to identify optimal pacing sites in patients with heart failure and to localize optimal ablation sites in patients with cardiac fibrillation.

Advantages: *We use a novel robust, stable and efficient finite element algorithm to systematically explore how the regional variation of cellular action potential profiles affects the repolarisation sequence in a human heart*

Disadvantages: *1) High computational cost and their large number of material parameters. 2) When mapped across the left ventricle, its depolarisation and repolarisation sequences are in excellent agreement with its clinically measured counterparts.*
Method used: *Finite Element Method*

C. Gradient Flows and Variational Principles for Cardiac Electrophysiology: Toward Efficient and Robust Numerical Simulations Of The Electrical Activity Of The Heart

The computer simulation of the electrical activity of the heart has experienced tremendous advances in the last decade. However, the acceptance of computational methods in the medical community will largely depend on their reliability, efficiency and robustness. In this work, we present a gradient-flow reformulation of the cardiac electrophysiology equations, and propose a minimax variational principle for the time-discretised electrophysiology problem. Based on results from variational analysis, we derive bounds on the time-step size that guarantee the existence and uniqueness of the saddle point, and in turn of the weak solution of the electrophysiology incremental problem. We also show conditions under which the minimax problem is equivalent to an effective minimization principle, which is amenable to a Rayleigh–Ritz finite-element analysis. The derived time-step bounds guarantee the strict convexity of the objective function resulting from spatial discretization, thus ensuring the convergence of gradient-descent methods.
The proposed theory is applied to the widely employed FitzHugh–Nagumo model, which is shown to conform to the variational framework proposed in this work. The applicability of the method and its implications on the robustness of time integration are demonstrated by way of numerical simulations of the electrical behaviour in a single-cell and 3D wedge and biventricular geometries. We envision that the proposed framework will open the door to the development of robust and efficient electrophysiology models and simulations.
Advantages: *The majorities of these models are multiscale in spirit, and therefore prove very useful in understanding the behaviour of cellular- and tissue-level mechanisms from the study of organ-level behaviour. The time-step bounds that arise from stability considerations for explicit methods become more stringent as the mesh size decreases, thus reducing the efficiency of those methods as a finer spatial discretization is considered.*
Disadvantages: *Virtually all deterministic cardiac electrophysiology models fall in the category of non-linear reaction–diffusion equations.*
Method: *Used Computational Method Gradient-descent method*

D. Lung Registration Using the Niftyreg Packagef

The EMPIRE 2010 grand challenge is a contest on lung imageb registration. This paper describes the implementation that has been used by the Niftyreggers team, as well as the results. The registrations were performed using a block-matching approach and the free-form deformation algorithm for global and local registration respectively. The NiftyReg package contains a global as well as a local registration algorithm. The global registration is based on a block-matching technique, as proposed by Ourselin. The local registration is based on the Free-Form Deformation (FFD) algorithm presented by Rueckert. The FFD technique has been re-factored by Modat to decrease the computation time, make the algorithm suitable for a Graphics Processing Units (GPU) implementation and improve the convergence trough an analytical formulation.

Advantages: *The method ensured that there were no singularities in any of the results. It was successful at aligning the lung boundaries, with less than 0.01 % error for any dataset.*
Disadvantages: *The amount of deformation changed greatly between datasets. Examination of the global results showed that for some cases the deformation could be reasonably well approximated by an a□ne transformation, whereas for others the deformation varied locally from one region to another, and could not be well approximated by an a□ne transformation.*
Method used: Least trimmed square (LTS) regression method

E. Nonrigid Registration Using Free-Form Deformations: Application to Breast MR Images

We present a new approach for the nonrigid registration of contrast-enhanced breast MRI. A hierarchical transformation model of the motion of the breast has been developed. The global motion of the breast is modelled by an affine transformation while the local breast motion is described by a free-form deformation (FFD) based on B-splines. Normalized mutual information is used as a voxel-based similarity measure which is insensitive to intensity changes because of the contrast enhancement. Registration is achieved by minimizing a cost function, which represents a combination of the cost associated with the smoothness of the transformation and the cost associated with the image similarity. The algorithm has been applied to the fully automated registration of three-dimensional (3-D) breast MRI in volunteers and patients. We have compared the results of the proposed nonrigid registration algorithm to those obtained using rigid and affine registration techniques. The results clearly indicate that the nonrigid registration algorithm is much better able to recover the motion and deformation of the breast than rigid or affine registration algorithms.

Advantages: *Voxel- based similarity measures, such as mutual information, with a nonrigid transformation model of the breast.*
Disadvantages: *Low sensitivity in dense glandular breast tissue, low specificity, and poor signal-to-noise ratio. Furthermore, the projective nature of the images and the exposure to radiation limit its applicability.*
Algorithm Used: *Nonrigid Registration algorithm.*

IV.SYSTEM ANALYSIS

EXISTING SYSTEM

In the existing system, it uses Active Contour based segmentation. First, both lungs are segmented by the active contour model. A masking technique is used for the initialization. This mask is partly preserved by our morphological processes after refinement. Through this mask, non-isolated nodes connected to the chest wall are transmitted to the isolated nodes, which can be easily detected. Then, regions of interest (ROIs) are detected using some stochastic 2D features. In this step, some segmental bronchi or bronchioles (small airways in the lung) could be detected in the ROI. This is the reason why 2D anatomical feature is used to detect the cancer. This is referred to as a robust and effective active contour modeling of thin edges, such as the boundary between the nodes and the lung wall. This algorithm has been tested on various types of images, including medical and non-medical. The results show its high performance and even its robustness on the noisy images. The active contour is applied to the original image with initialization. If some small parts have not been recognized by the lung segmentation algorithm, they are segmented using image as an input of the active contour model. Finally, recognized cancers are used as initial masks of active contour modeling to accurately extract the contours of nodes.

DISADVANTAGES:

Time consuming and Accuracy is not perfect one and it will not adapt with different images.
When image size is too large, this method works slowly.
It is not capable to segment the nearest objects.
This method is not so good for video related operations.

PROPOSED SYSTEM

The proposed method is to remove the noise from the input image. The features are preprocessed and segment the image with the help of input lung image. The input lung image is segmented as binary image. After segmented the image we will apply the watershed segmentation to the image. After that we can identify the cancer spots that will helpful easily identified the affected area. In visualization, we can classify that the persons who are all smoking can be categorized as bronchitis and lung cancer. Based on the probability we will easily identify the persons who are all affected by lung cancer. After that we can analyze the performance analysis based on our condition finally we can identify the person will be affected by lung cancer or not. An important task was to identify the characteristics for an initial picture of the successful detection of lung cancer. It is of great importance to find a random association as well as a correlation between and among the cancer indication features extracted from the image to develop a very successful diagnostic system. Therefore, the type of data collected from different sources (different patients and subject pictures). Therefore, the nature of the data was analyzed using regression techniques.

ADVANTAGES

The watershed lines always correspond to the most significant edges between the markers. So this technique is not affected by lower-contrast edges, due to noise, that could produce local minima, and, thus, erroneous results, in energy minimization methods. Even if there are no strong edges between the markers, the watershed transform always detects a cancer in the area. This cancer will be located on the pixels with higher contrast.

V. SYSTEM SPECIFICATIONS

HARDWARE REQUIREMENTS

- *Processor: Intel core2 Duo*
- *Speed: 2.93 GHz*
- *RAM: 4GB RAM*
- *Hard Disk: 500 GB*
- *Key Board: Standard Windows Keyboard*

SOFTWARE REQUIREMENTS

- *Operating System: Windows 7*
- *Image Processing Application: MATLAB-2016a*

VI. DESIGN ELEMENTS

INTRODUCTION

Region is a simple regional image segmentation method. It is also classified as a pixel-based image segmentation method, since it includes the selection of initial seed points. This approach for segmentation examines neighbouring pixels from initial start points and determines whether the pixel neighbours are to be added to the region. The process is iterated in the same way as the general data clustering algorithms. The main goal of segmentation is to share a picture in regions. Some segmentation methods such as thresholding achieve this goal by searching the boundaries between regions based on discontinuities in grayscale or color properties. Regional segmentation is a method for the direct determination of the region. The Watershed transform has interesting properties that make it useful for a much different image segmentation application. Watershed transformation is a powerful tool for image segmentation based on mathematical morphology. A water wave transformation as a means of separating overlapping objects.

We can view the image as a landscape or a topographic relief, interpreting the gray level of each pixel as its height in the relief. Immersing the landscape into a lake with holes pierced in local minima begins with water beginning at these local minima. At points where water comes from different basins, dams are built. This process ends when the water reaches the highest point of the landscape. Consequently, the landscape is divided into regions or basins separated by dams, which are called water-cutting or simply water-cutting. The benefits of the WASP transformation are that it is simple, instinctive knowledge, and can be parallelized. The main disadvantage of this method is the over-segmentation due to the presence of many local minima. To reduce the effect of a strong over-segmentation, labelling-controlled water table transformations have been proposed. These are robust and flexible methods for segmenting objects with closed contours. The internal marking and the external marking are defined first. The boundaries, even if not clearly defined, are expressed as ribs between two markers. In the marker-controlled water-cutting process for segmenting the image, the external marking is obtained manually by drawing a circle that encloses an object of our interest. The internal marker is automatically determined by combination techniques, including canny edge detection, thresholding, and morphological operation.

INPUT DESIGN:

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system. The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input Design considered the following things:

- *What data should be given as input?*
- *How the data should be arranged or coded?*
- *The dialog to guide the operating personnel in providing input.*
- *Methods for preparing input validations and steps to follow when error occur.*

Figure 2. Dilated image

OUTPUT DESIGN

A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design, it is determined how the information is to be displaced for immediate need and the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.

1. *Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should Identify the specific output that is needed to meet the requirements.*
2. *Select methods for presenting information.*
3. *Create document, report, or other formats that contain information produced by the system.*

The output form of an information system should accomplish one or more of the following objectives.

- *Convey information about past activities, current status or projections of the future.*
- *Signal important events, opportunities, problems, or warnings.*
- *Trigger an action.*
- *Confirm an action.*

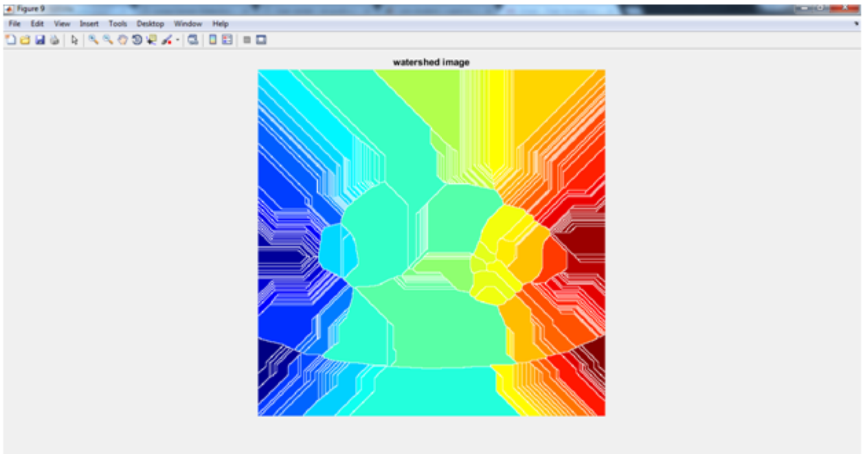

Figure 3. Apply watershed Segmentation

VII. CONCLUSIONS

CONCLUSION

Medical image segmentation has great potential in the medical field. Watershed segmentation method can be used on a variety of images and in a wide range of applications. This shows a segmentation algorithm for lung x-ray images. Further obtained segments can be used as a diagnostic aid for content-based medical imaging. We have obtained segmentation tools on several pulmonary images of the lung, which is from NIH / NCI Lung Image Database Consortium (LIDC) data set that provides the opportunity to perform the proposed research. The test results show that the proposed method can improve the speed, robustness and accuracy of the diagnosis since the physician can assess a case at the right time.

Figure 4. Cancer Spot image

Therefore, this technique is very useful for research for medical fraternity and students. Based on this study, the water-cutting segmentation technique is good for evaluating the lung cancer cell region.

FUTURE WORK

For the future work, we can implement this technique on some more pictures. Increasing the number of images used for the process, can improve the accuracy. MRI, CT, PET images can also be considered for this technique. The comparison can be made for all these images. Thus, one can justify which types of images have better outcomes for lung cancer detection.

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