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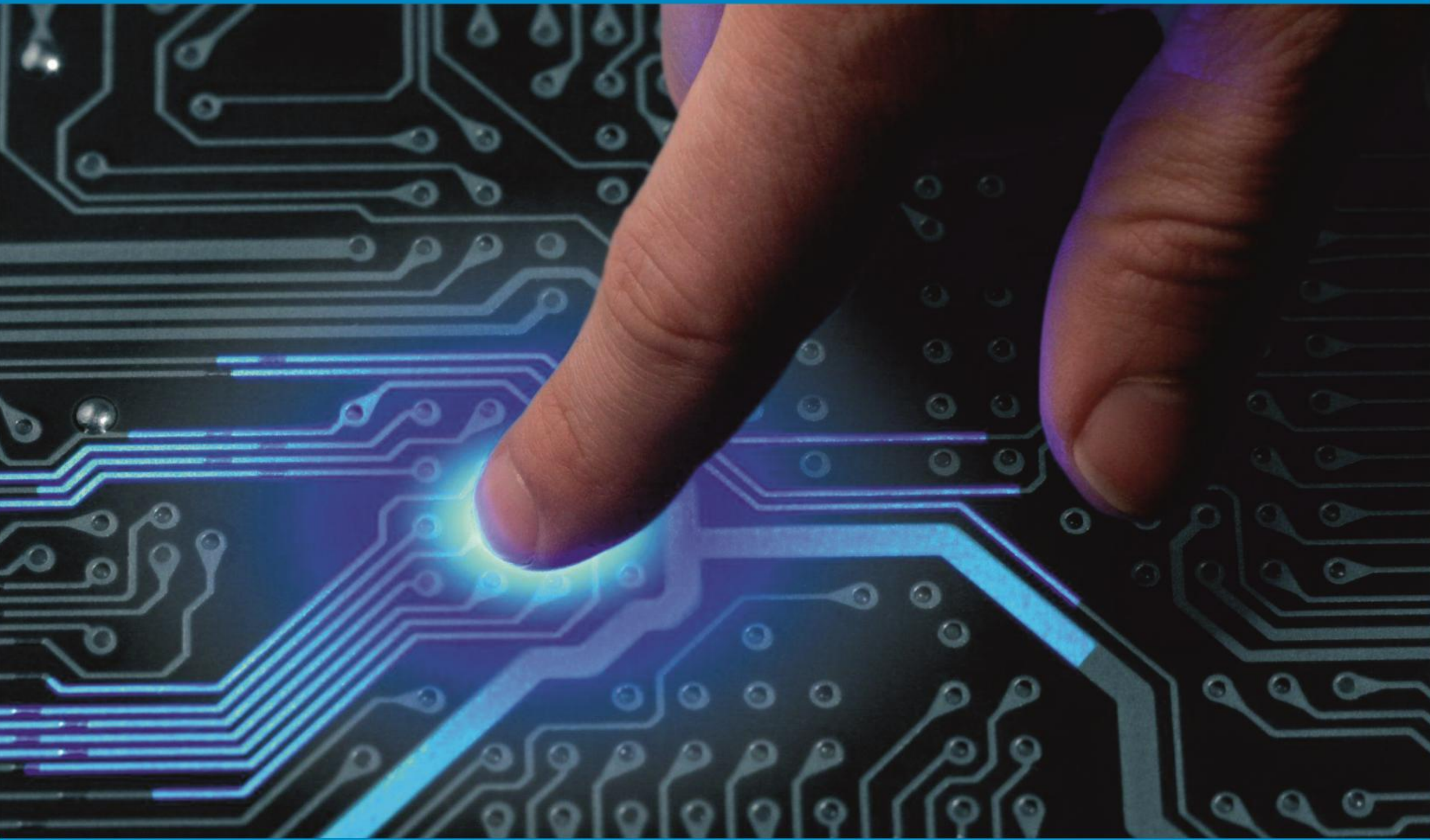

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Deduction of Lung Cancer with Digital Image Processing Over CT Scan Images

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ABSTRACT: This study aims to highlight the significance of data analytics and machine learning in prognosis in health sciences, particularly in detecting life threatening and terminal diseases like cancer. Here, we consider lung cancer for our study. For this purpose, preexisting lung cancer patients' data are collected to get the desired results. A predictive algorithm is developed to predict the probability of a patient catching lung cancer based on dataset comes from the Data Science Bowl 2017. Data set (in the form of diagnostic images) is run past Matlab for analysis and forecasting. Image processing is employed for this purpose. Medical image segmentation and classification are done to achieve this. Classification depends on features extracted from the images. The emphasis is on the feature extraction stage to yield better classification performance. Image quality and accuracy is the core factors of this research, image quality assessment as well as improvement are depending on the enhancement stage where low pre-processing techniques is used based on Gabor filter within Gaussian rules. Following the segmentation principles, an enhanced region of the object of interest that is used as a basic foundation of feature extraction is obtained. This information is then fed to machine learning algorithms to discern a pattern that can give some good insights into what combination of features are most likely to result in an abnormality.

I. INTRODUCTION

Lung cancer is a disease of abnormal cells multiplying and growing into a tumour. Cancer cells can be carried away from the lungs in blood, or lymph fluid that surrounds lung tissue. Lymph flows through lymphatic vessels, which drain into lymph nodes located in the lungs and in the centre of the chest. Lung cancer often spreads toward the centre of the chest because the natural flow of lymph out of the lungs is toward the centre of the chest. Metastasis occurs when a cancer cell leaves the site where it began and moves into a lymph node or to another part of the body through the blood stream [1].

Cancer that starts in the lung is called primary lung cancer. There are several different types of lung cancer, and these are divided into two main groups: Small cell lung cancer and non-small cell lung cancer which has three subtypes: Carcinoma, Adenocarcinoma and Squamous cell carcinomas. The rank order of cancers for both males and females among Jordanians in 2008 indicated that there were 356 cases of lung cancer accounting for (7.7 %) of all newly diagnosed cancer cases in 2008. Lung cancer affected 297 (13.1 %) males and 59 (2.5%) females with a male to female ratio of 5:1 which Lung cancer ranked second among males and 10th among females [2]. Figure 1 shows a general description of lung cancer detection system that contains four basic stages.

The first stage starts with taking a collection of CT images (normal and abnormal) from the available Database from IMBA Home (VIA-ELCAP Public Access) [3]. The second stage applies several techniques of image enhancement, to get best level of quality and clearness. The third stage applies image segmentation algorithms which play an effective rule in image processing stages, and the fourth stage obtains the general features from enhanced segmented image which gives indicators of normality or abnormality of images.

Lung cancer is the most dangerous and widespread cancer in the world according to stage of discovery of the cancer cells in the lungs, so the process early detection of the disease plays a very important and essential role to avoid serious advanced stages to reduce its percentage of distribution. The aim of this research was to detect features for accurate images comparison as pixels percentage and mask-labelling.

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II. LITERATURE SURVEY

AUTOMATED METHOD BASED ON SPATIO-TEMPORAL WATERSHED CUTS

We propose a new automated and fast procedure to segment the left ventricular myocardium in 4D MRI sequences. Both quantitative and qualitative evaluations are provided. We demonstrate the accuracy of the proposed method. Here we used discrete mathematical morphology. The time efficiency is high. The accuracy of the automated method compared to manual segmentations performed by two cardiologists; the ability of the method to compute reliable characteristics of the LV (ejection fraction and left ventricular mass); the temporal continuity of the resulting automated segmentation; the time-efficiency (about 3' to segment a sequence of 25 3D-images on a low-end computer) of the proposed method; and the robustness of the few parameters whose setting rely mostly on physical and anatomical facts. MR images of the LV, together with three associated segmentations: two handmade segmentations – each one of them performed by an independent and blinded expert cardiologist and one 4D automated segmentation obtained by the proposed method. The first objective of this paper is to show that mathematical morphology offers interesting alternatives to these approaches in the important and difficult task of designing cardiac segmentation methods that can be used in clinical routine. We introduced the watershed cuts, a notion of watershed in edge-weighted graphs which is optimal in a sense equivalent to minimum spanning trees. This paper presents the first application of this new paradigm. Furthermore, this paper introduces the watershed-cuts in 4-dimensional spaces (3D+time). Our second objective is to show the ability of this operator to take into account both the spatial and temporal gradient of the images and therefore its ability to produce segmentations that are spatially as well as temporally consistent. The proposed method is evaluated on cine-MR image following by this sequence

Since it is independent of any high-level model, the proposed method can be used to fairly assess model-based segmentation schemes by comparing their results with our non-model based segmentation, hence, discarding bias due to the choice of different models. Furthermore, the proposed method can be used to register generic physiological models of the heart to real patient specific cardiac images. In general, it is indeed easier to register a model to a binary segmentation than directly to images. So we introduce in this paper a new watershed framework which allows for segmenting spatio temporal images that we apply to medical image analysis. Specifically, we propose a new automated and fast procedure to segment the left ventricular myocardium in 4D (3D+t) cine-MRI sequences. The successive segmentations obtained over the time take into account spatio-temporal properties of the images. Thanks to the comparison with manual segmentation performed by two cardiologists, we demonstrate the accuracy of the proposed method and the relevance of the ejection fraction and myocardium mass derived from the automated segmentations. Therefore, this automated method can be used in clinical routine. The proposed scheme does not permit the direct derivation of deformation parameters. Such deformation parameters can be obtained thanks to a model of the heart movement, and such a heart model needs the obtained segmentations as control points. Future work will aim at computing deformation fields whose accuracy will be improved by registration with other modalities such as delayed enhanced MRI and CT scan.

III. SYSTEM ANALYSIS

3.1 PROBLEM IDENTIFICATION

In the scheme does not permit the direct derivation of deformation parameters. Detection accuracy is low. This particularly complex segmentation task, prior knowledge is required. Major challenges linked to this segmentation task. Image processing and pattern recognition problems are occurring. The LBP method has proved to outperform many existing methods, including the linear discriminate analysis and the principal component analysis. The system presented not only enables classification of whole images but also presents a better performance for sub images when compared with some of the existing systems.

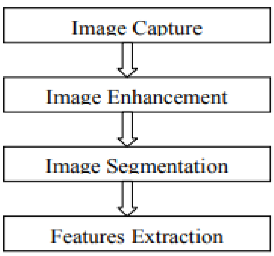

Figure 1. *Lung cancer image processing stages*

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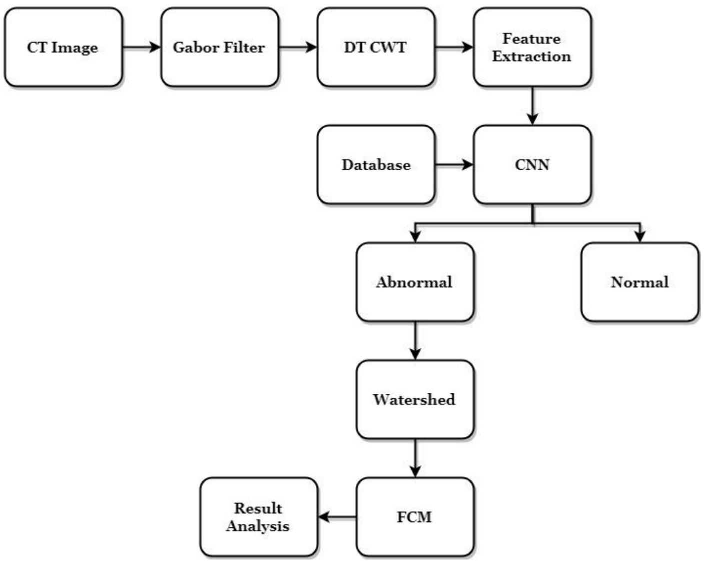
3.2 EXISTING SYSTEM

This paper presents techniques that are required to achieve an automatic classification system to diagnosis the presence of the acute Lung cancer from CT scan images. This is important because segmentation of nucleus is much easier than the segmentation of the entire cell, especially in the bone marrow where the white blood cell density is very high. In the experiments, a set of manually segmented images of the nucleus are used to decouple segmentation errors.
A microscopic blood image of size 184×138 is considered for evaluation.

3.3 PROPOSED SYSTEM

The proposed technique has been applied on peripheral lung smear images obtained from two places, as aforementioned. The presented system performs automated processing, including color correlation, segmentation of the affected cells, and effective validation and classification. A feature set exploiting the shape, color, and texture parameters of a CD images are constructed to obtain all the information required to perform efficient classification. The impact of the LBP operator on the HD proved to be a promising feature for this analysis. Furthermore, a color feature called cell energy was introduced, and results show that this feature presents a good demarcation between cancer and non cancer cells.

3.4 ARCHITECTURE



IV. SYSTEM IMPLEMENTATION

Image Enhancement The image Pre-processing stage starts with image enhancement; the aim of image enhancement is to improve the interpretability or perception of information included in the image for human viewers, or to provide better input for other automated image processing techniques.

4.1 Gabor Filter

Image presentation based on Gabor function constitutes an excellent local and multiscale decomposition in terms of logons that are simultaneously (and optimally) localization in space and frequency domains [5]. A Gabor filter is a linear filter whose impulse response is defined by a harmonic function multiplied by a Gaussian function. Because of the multiplication-convolution property (Convolution theorem), the Fourier transform of a Gabor filter's impulse response is the convolution of the Fourier transform of the harmonic function and the Fourier transform of the Gaussian function.

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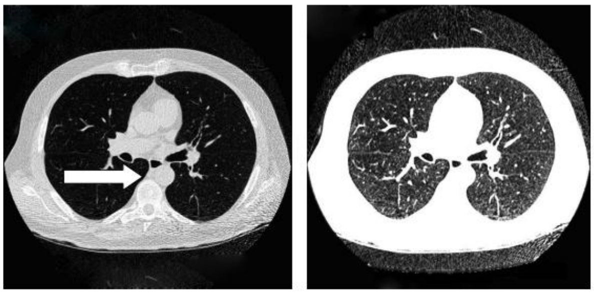
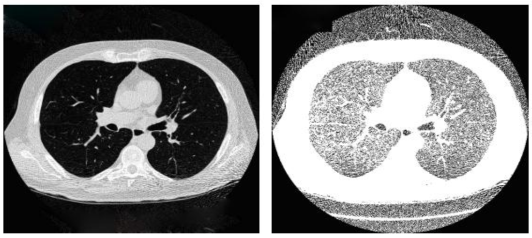


Figure 2 describes (a) the original image and (b) the enhanced image using Gabor Filter.

Auto enhancement method is strongly depends on subjective observation and statistical operations such as mean and variance calculation. The enhancement percentage in this research was equal to 38.025%.

4.2 Fast Fourier Transform

Fast Fourier Transform technique operates on Fourier transform of a given image. The frequency domain is a space in which each image value at image position F represents the amount that the intensity values in image "I" vary over a specific distance related to F. Fast Fourier Transform is used here in image filtering (enhancement). Figure 3 describes the effect of applying FFT on original images, where FFT method has an enhancement percentage of 27.51%.



(a) Original Image (b) Enhanced by FFT

Figure 3. Auto enhancement technique using FFT

Table 1 shows a comparison of the three mentioned techniques used for image enhancement. According to the values shown in the Table 1, we can conclude that the Gabor Enhancement is the most suitable technique for image enhancement. Observing the images enhanced by this method, we notice that new image details have appeared, in addition to good clearance and brightness shown by the enhanced images.

4.3 Image Segmentation

Image segmentation is an essential process for most image analysis subsequent tasks. In particular, many of the existing techniques for image description and recognition depend highly on the segmentation results [7]. Segmentation divides the image into its constituent regions or objects. Segmentation of medical images in 2D, slice by slice has many useful applications for the medical professional such as: visualization and volume estimation of objects of interest, detection of abnormalities (e.g. tumours, polyps, etc.), tissue quantification and classification, and more [8].

4.4 Thresholding approach

Thresholding is one of the most powerful tools for image segmentation. The segmented image obtained from thresholding has the advantages of smaller storage space, fast processing speed and ease in manipulation, compared with gray level image which usually contains 256 levels. Therefore, thresholding techniques have drawn a lot of attention during the past 20 years [10]. Thresholding is a non-linear operation that converts a gray-scale image into a binary image where the two levels are assigned to pixels that are below or above the specified threshold value. In this research, Otsu's method that uses (gray thresh) function to compute global image threshold is used. Otsu's method is based on threshold selection by statistical criteria.

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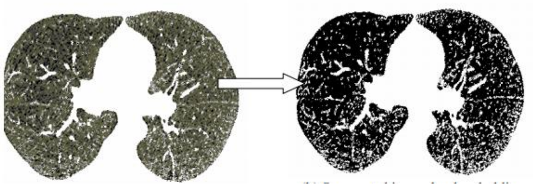
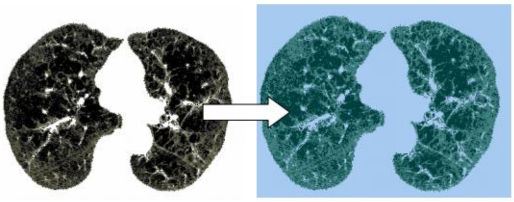


(a) Enhanced image by Gabor (b) Segmented image by thresholding
Figure 4. Normal enhanced image by Gabor filter and its segmentation using thresholding approach

5.5 Marker-Controlled Watershed Segmentation Approach

Marker-driven watershed segmentation technique extracts seeds that indicate the presence of objects or background at specific image locations. Marker-controlled watershed approach has two types: External associated with the background and Internal associated with the objects of interest. Image Segmentation using the watershed transforms works well if we can identify or "mark" foreground objects and background locations, to find "catchment basins" and "watershed ridge lines" in an image by treating it as a surface where light pixels are high and dark pixels are low. Figure 5 shows a segmented image by watershed.



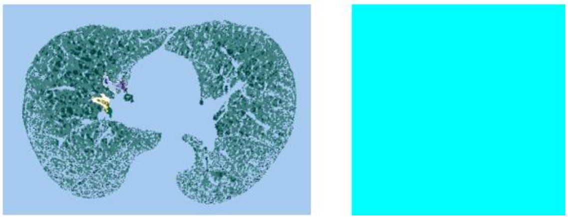
(a) Enhanced image by Gabor (b) Segmented image by Watershed
Figure 5. Normal Enhanced image by Gabor filter and its Segmentation using MarkerControlled Watershed approach

5.6 Features Extraction

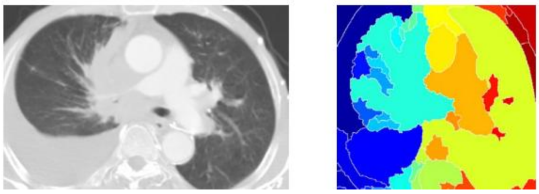
Image features Extraction stage is an important stage that uses algorithms and techniques to detect and isolate various desired portions or shapes (features) of a given image. To predict the probability of lung cancer presence, the following two methods are used: binarization and masking, both methods are based on facts that strongly related to lung anatomy and information of lung CT imaging.

5.7 Masking Approach

Masking approach depends on the fact that the masses are appeared as white connected areas inside ROI (lungs), as they increase the percent of cancer presence increase. The appearance of solid blue colour indicates normal case while appearance of RGB masses indicates the presence of cancer, the TAR of this method is (85.7%) and FAR has (14.3%). Figure 8 shows normal and abnormal images resulted by implementing Masking approach using MATLAB.



(a) Normal Image enhanced by Gabor, segmented by watershed (b) The resulted image indicates normality



(c) Abnormal image (d) The resulted indicates abnormality

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Figure 8. Normal and abnormal images using Masking approach Combining Binarization and Masking approaches together will lead us to take a decision whether the case is normal or abnormal according to the mentioned assumptions in the previous two approaches, we can conclude that image that has number of black pixels greater than white ones, indicates normality, and otherwise it indicates abnormality.

V. CONCLUSIONS

An image improvement technique is developing for earlier disease detection and treatment stages; the time factor was taken in account to discover the abnormality issues in target images. Image quality and accuracy is the core factors of this research, image quality assessment as well as enhancement stage where were adopted on low pre-processing techniques based on Gabor filter within Gaussian rules. The proposed technique is efficient for segmentation principles to be a region of interest foundation for feature extraction obtaining. The proposed technique gives very promising results comparing with other used techniques. Relying on general features, a normality comparison is made. The main detected features for accurate images comparison are pixels percentage and mask-labelling with high accuracy and robust operation.

VI. FUTURE ENHANCEMENT

In future idea to make a combination with genetically defined mouse models of lung cancer; these new technologies hold particular promise for the discovery of potentially useful biomarkers. Future directions include the further refinement of existing mouse models, such as the sequential activation or inactivation of target genes, to more closely mimic the accumulation of genetic alterations in human lung tumor genesis.

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