Indian J.Sci.Res. 17(2): 193-197, 2018 ISSN: 0976-2876 (Print)
ISSN: 2250-0138(Online)

PRELIMINARY QUANTITATIVE ANALYSIS OF LUNG NODULE EXTRACTION FROM NOISE IMAGE

[1] V. Kalpana, [2] V. Vijaya Kishore
[1] Department of Electronics and Communication Engineering, Sree Vidyanikethan Engineering College, Tirupathi
[2] Department of Electronics and Communication Engineering, G. Pullaiah College of Engineering & Technology, Kurnool

Abstract **–** lung cancer has the highest epidemiology than all other cancer types with 29 percent in men and 26 percent in women. Cancer is a genetic disease that is caused by changes to genes that control the way our cells function, especially how they grow and divide. If cancer is detected in its stage I, out of 100 people 75 can survive but if its detected at stage IV only 5 can be survived. As per the surveys made 65 percent of lung cancer is diagnosed with a 5 year survival rate of only 3.5 percent. With early detection and surgery in time the survival rates are 85 percent. Due to disproportionate high prevalence and mortality of advanced lung cancers, many attempts were made to detect early lung cancer. Diagnosis of lung cancer depends on the identification of nodules known to be malignant. These nodules may vary in size, shape and also remain close to chest walls. Identification of these nodules is a difficult task but can be made possible by incorporating the segmentation techniques. This paper elucidates the best suitable technique to obtain the lung portion even if the image is proned to noise. This paper extracts the region of interests from a DICOM image using different segmentation operators and transforms. The outcome may assist the specialist to forecast the extent of disease and help in further treatment to control the deceasing rates.

Keywords- Lung cancer, cancer cells, Noise, DICOM, Nodules, ROI.

I. Introduction

Lung cancer is persuading the medical groups and research associations with alarming death rates due to lung cancer. Recognising the tumour at its inceptive level can ameliorate the existence possible to 70%. To extract the lung portion of tumour several segmentation techniques can be used. When the medical image gets processed it may be feasible to noise. Medical images can be collected from different sources like scans. The major problem lies in identifying the extent of tumour spread. To clearly locate the shape and size of the nodules, image processing applications are used [1]. Medical images may contain noticeable reflections that can mislead the results. The basic need is to eliminate the insignificant portions to procure the ROI [2]. Segmentation has a great deal in portioning the image from the irrelevancies and to make the image more understandable. To extricate the disfiguring and abnormalities that concern to malignancy, various segmentation operators are widely used [3]. Image acquisition is done using different modalities like CT, PET, US, MRI and DICOM. Image are examined using computer aided diagnosis systems to avoid incredulity [4]. CT screening helps to detect cancers that are invisible in CXR. Progression of lung cancer has different ways of treatments like surgery and radiation (1970), chemotherapy (1980), chemotherapy combinations (1990), targeted therapy plus chemotherapy (2000) and at present immunotherapy [5]. DICOM is categorised images relating to structures and CAD systems are grouped and morphological techniques that can clearly identify the nodules [6].

II. Lung Cancer

Cancer is a category of ill health caused due to unusual thickening of cells that probably spread to other parts of the body. In all types of cancers, cells break-up without stopping proliferate with surrounding tissues. As human system is build with trillions of cells cancer can originate from anywhere. As cells become more and more abnormal, old or damaged cells survive when they should die, and new cells form when they are not needed [8]. These extra cells can divide without stopping and may form growths called tumors. Many cancers form solid tumors, which are masses of tissue. The figure 1a shows the formation of tumour and figure 1b shows lung formed with cancer. Cancers of the blood, such as leukemias, generally do not form solid tumors. Cancerous tumors are malignant, which means they can spread into, or invade, nearby tissues [14]. In addition, as these tumors grow, some cancer cells can break off and travel to distant places in the body through the blood or the lymph system and form new tumors far from the original tumor. Benign tumours donot spread and cause damage as malignant tumours. Benign tumors cant grow back once they are removed [16].

[1]Corresponding Author

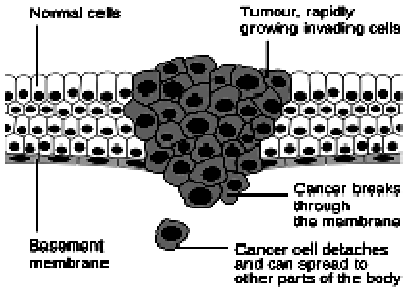

Fig. 1a. Formation Of Tumour And Spreading Of Cancer To Other Parts.

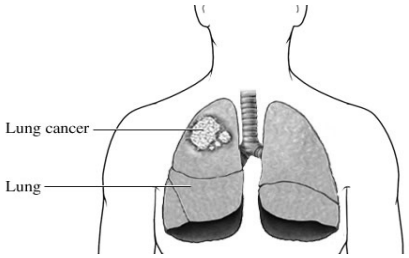

Fig. 1b. Lung showing cancer.

cancer that has spread from the place where it first started to another place in the body is called metastatic cancer. There are more than 100 types of cancer. Types of cancer are usually named for the organs or tissues where the cancer forms. Cancer may likely invade and affect the parts like lung & bronchus, prostate, breast, colon & rectum, pancreas, ovary, leukaemia, uterine corpus, urinary bladder, liver & intrahepatic bile duct, brain, kidneys and other nervous systems [3, 17]. Figure 2a and 2b shows can from a live lung image.

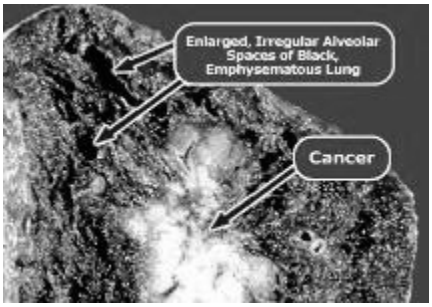

Fig. 2a. Cancer Due To Abnormal Increase Of Air Spaces, Pulmonary Emphysema.

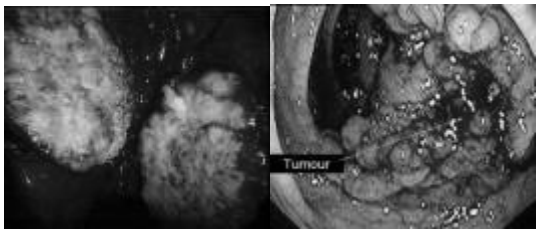

Fig. 2a. Cancer/Tumour Of A Live Lung.

Smoking is the highest risk factor for Lung cancers. 17.9% of lung cancers are never smokers, 60% are former smokers and 20.9% are current smokers. Figure 3 shows the comparison of smoker lung with healthy lung [8]. Apart from smoking lung cancers are caused because of air pollution, inhaling of toxic chemicals or radioactive gases, food habits, prior radiation and genetics [18].

Fig. 3. Comparison Of Healthy And Smoker Lung.

There are two types of lung cancers, small cell and non-small cell lung cancers. 15% are non-small cell lung cancers and non-small cell lung cancers involve squamous cell carcinoma (30%), adenocarcinoma (40%) and large cell carcinoma (15%). Adenocarcinoma are found in non smokers near the edge of the lung, squamous cell carcinoma are related to smoking and it spreads beyond bronchi resulting in coughing up blood, large cell carcinoma are tumours that spread quickly usually greater than 1-1/2 inches [14]. The signs of lung cancer are wheezing, shortness of breath, persistent and worsening cough, hoarseness or change in voice quality, coughing up blood, frequent pneumonia and chest pain [16]. The evaluation and diagnosis of tumours can be performed by chest x-rays, CT scans or PET scans and precautionary actions include stopping of smoking, avoid exposure to toxic chemicals, healthy diet and physical exercise [19].

III. Cancer cells Vs Normal cells

Cell division is a normal process used by the body for growth and repair. Normal cells appear regular in shape and have proportionate size. For division normal cells require external growth factors and if these cells have contact with other cells they stop division. These cells get aged and die after a limited time specified as apoptosis. Normal cells have controlled growth and normal chromosomes [8, 14]. Normal cells are specialised cells and stay in organs. They undergo maturation and senescence. Normal cells have organised arrangement and even appearance and even shaped nuclei. Figure 4a, 4b, 4c shows the formation of normal cells in to cancer cells. Cancer cells are irregular and they grow out of control. They do not die and are invisible to immune cells. They will not depend on growth factors for cell division and the cells continue to grow even after they touch the other cells [18]. These cells divide infinitely and metastasize. They are nonspecialized cells with abnormal chromosomes and uncontrolled growth. These cells have disorganised

arrangement with variable appearance and variable shaped nuclei.

Fig.4a. Cancer Cell Growth Live Image

Fig. 4b. Normal cell developing into tumour.

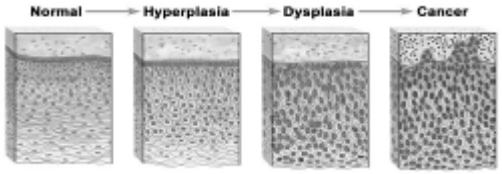

Fig. 4c. Normal Cells Forming Into Cancer Cells.

IV. Segmentation Techniques

Segmentation changes the representation of image that makes it easy to understand and analyse. Segmentation procedure has to stop when the required regions of interest are attained. Image Segmentation for medical image is done to extract the boundaries of 2D or 3D images such that the image can be legibly vouched [18]**.** Segmentation can analyse and interpret the image regions with the features of interest. Medical Images has a challenging problem to accurately partition the image from other areas as the analysis depends on the reliability of image segmentation [7]. Edge based segmentation techniques are used for images that have better contrast between the objects but it cannot be suitable for detecting too many edges. When the image has noise then edge detection techniques extract the boundaries along with noise. So watershed segmentation technique can be used. Watershed method is based on topological interpretation in which the results are more stable and the detected boundaries are continuous. The only disadvantage with watershed method is computational complexity [13, 15]. In this paper as the image is used alone with noise, the extraction of image is done using morphological operations using structuring element [10]. These operations eliminate irrelevancies. The main objective of this paper is to extract the region of interest even when the image is proned to noise and the capability of the operator to extract the ROI [17]. The operators used to extract the ROI are Sobel, prewitt, average using morphological method. Sobel operator performs 2D spatial gradient measurement of image and emphasizes high frequency spatial regions corresponding to edges [9]. Prewitt operator is a discrete differential operator to compute gradient based on image intensity. Average operator is called as mean filtering used for smoothing images and to reduce intensity variations between the pixels [11]. Images are acquired using DICOM which has the capability to share and store images regardless of machine, method. DICOM provides much ease and flexibility in work with less effort, encoding the medical data [17]. The complexity of lung cancer lies in identifying the masses that are malignant nodules with diverse shapes and appearance [12].

V. Results

The results are extracted using different edge segmentation operators like Sobel, Prewitt and Average with adding of Gaussian noise. The ROI extracted using the operators is shown in figure 5 (a, b, c & d). The best suitable operator is identified with the extraction of ROI even image contains noise.

Table 1. PSNR And MAE For ROI Of Lung Image With Gaussian Noise And Segmentation Operators.

Parameters	Sobel operator	Prewitt operator	Average operator
PSNR	75.5584	77.8602	74.7195
MAE	0.0018	0.0011	0.0022

The exactness of the results are evaluated by a parameter, mean absolute error and PSNR. Mean absolute error measures the difference between two continuous variables. PSNR measures the quality of reconstruction and the impact of noise on the image. The values of the image before adding noise and after adding noise are considered to analyse the results. The values for the considerable regions of interest are shown in the table 1.

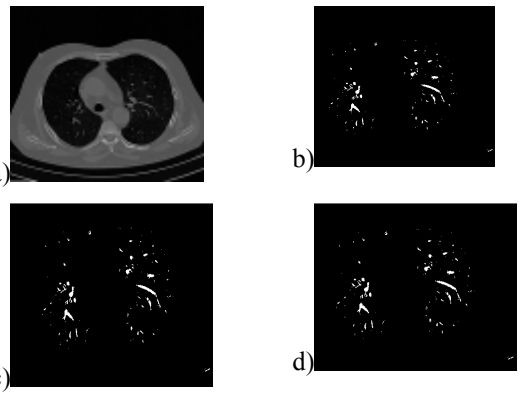

Figure5. (a) DICOM image, (b) ROI with Sobel operator (c) ROI with Average operator (d) ROI with Prewitt operator

VI. Conclusions and Future Scope

Detection of nodules is a dependable technique for confirmation of lung abnormality and further enhances the survival rates. This work contrivances medical image segmentation methods and morphological operations and watershed transforms by applying Gaussian noise. The analysis of results is concluded by mean absolute error and peak signal to noise error. The prewitt segmentation operator achieves best results in extracting the ROI even the image is corrupted with noise. Sobel operator obtains the regions of image as like prewitt by resisting to noise. Average operator can partially resist to noise and identifies the nodules but not better than prewitt and sobel operator.

This work can be extended with other existing operators and in different noise environments and the impact of extraction depends on morphological operators that further rely on structuring element shape and sizes. This paper can also be extended for real processing of medical images with the removal of noise. Better results helps for the early diagnosis and the experts for prognosis.

References

[1] H. Chidiac, D. Ziou, "Classification of image Edges", Vision interface'99, Troise-Rivieres, Canada, 1999.pp. 17-24.

[2] Zhao Yu qian , Gui Wei-hua "Medical Images edge detection Based on Mathematical Morphology "Proceedings of 2005 IEEE Engineering in Medicine and Biology 27th Annual Conference, sep-2005.

[3] V.Kalpana, Dr S Varadarajan and T. Milinda purna, "Performance evaluation of DICOM Lung ROI with different sizes of morphological structuring elements and noise", International journal of applied engineering research, vol. 10, no.6 pp.4991-4996, 2015.

[4] Speeuwers, L. j. Heijden, F. Vander, "Evaluation of Edge Detectors using Average Risk", Robust Computer Vision (Eds: Forstner/Ruwiedel), Wichmann, Karlsruhe: 1992.

[5] Tuba Sirin, Mehmet Izzet Saglam et al. "A Comparative Evaluation of Competitive Learning Algorithms for Edge detection Enhancement",

[6] Shin. M. C, Goldgof. D. B, Bowyer.K.W, Nikiforou.S, "Comparision of edge detection algorithms using structure from motion task" Systems, Man and Cybernetics, Part B, IEEE Transactions vol 31,Issue 4, pp.589-601,2001.

[7] V. Vijaya Kishore, R V S. Satyanarayana, "A Multi-Functional Interactive Image processing tool for lung CT images", International Journal of Biomedical and clinical Engineering, 2(1), 1-11, January-June 2013.

[8] V. Kalpana, Prof GK Rajini, "segmentation of lung lesion nodules using DICOM eith structuring elements and noise-A comparative study", IEEE digital xplore library DOI: 10.1109/UPCON.2016.7894661.

[9] Mohsen Sharifi, Mahmoud Fathy, "A Classified and Comparitive Study of Edge detection Algorithms", Proceedings of International Conference on Information Technology: Coding and Computing (ITCC'02) IEEE 2002.

[10] Mohamed Roushdy, "Comparitive Study of Edge detection Algorithms Applying on the Gray Sacle Noisy Image using Morphological Filter", GVIP Journal, Vol-6, Issue-4,Dec-2006.

[11] R. M. Haralick, L. g. Slhapiro, "Computer and Robot Vision", Vision 1, Addition- Wesley Publishing Company Inc., 1992.

[12] Albovik,"Handbook of Image and video Processing", Academic Press, 2000.

[13] P. Garcia, F. Pla, I. Garcia, "Detecting Edges in colour Images using dichromatic Differences", Seventh International IEEE Conference on Image processing and ITS Applications, volume: 1, 1999.pp.363-367.

[14] V. Vijaya Kishore, R V S. Satyanarayana, "A modified mathematical morphology-based approach for medical image edge detection and restoration", The IUPJournal of Electrical and Electronics Engineering, Volume 5, Issue 2, 2012.

[15] S. G. Chang, Y. Binand, M.Vetterli:"Adaptive wavelet thresholding for image denoising and compression", IEEE Trans. On Image Processing, vol.9, no.9, pp. 1532-1546, sep 2006.

[16] V. Vijaya Kishore, R V S. Satyanarayana, "Comparative study of performance of edge detecting methods on medical image in the presence of Gaussian and poisson noise", International Journal of Electronics and Electrical Engineering, Volume 5, Issue 7, June 2009.

[17] V. Kalpana and V. Vijaya Kishore, "Performance study of different medical images based on morphology in noisy environment", International journal of advanced research in engineering and technology, vol. 2, no.1 pp.158-168, 2013.

[18] V. Vijaya Kishore, R V S. Satyanarayana, "Computer-Aided Diagnosis Tool for Honeycomb Detection by using Morphology and Wavelet Transform in Lung CT Images", IFRSA's International Journal Of Computing|Vol2|issue 2|April 2012.

[19] Cronin, P. et al. Solitary Pulmonary Nodules: Meta-analytic Comparison of Cross-sectional Imaging Modalities for Diagnosis of Malignancy. *Radiology*. 2008, 246:772-782