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Cad Implementation for Detection of Lung Cancerous Nodules

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Abstract: Cancer is a disease characterized by uncontrolled growth of abnormal cells. Globally lung cancer is more prevalent and is the leading cause of deaths for both men and women. It is difficult to detect lung cancer at an early stage. The five year survival rate for all stages combined is only 14%. Early detection and treatment of lung cancer is important in order to improve the survival rate of cancer patients. Medical imaging plays an important role in the early detection and treatment of cancer. Image processing algorithms and techniques are applied on the images to clarify and enhance the image and then to separate the area of interest from the whole image.In this paper, after applying Mean Shift Algorithm, a novel mathematical morphological edge detection algorithm is proposed to detect the edge of lungs CT image with salt-and-pepper noise. The experimental results show that the proposed algorithm is more efficient for medical image denoising and edge detection. The extraction and segmentation results can be used as a base for a CAD system for detection of lung cancer which will improve the chances of survival for the patient. The average accuracy of proposed algorithm is more than 90% and has faster execution time.

Keywords- Lung Cancer, CT scan, edge detection, mean shift.

I. INTRODUCTION

CANCER is one of the most serious health problems in the world, accounting for 8.2 million deaths in 2011-12[1]. Globally lung cancer is the most common cause of cancer-related deaths. According to the report of World Health Organization (WHO), death rate caused by lung cancer has already jumped to the highest among all cancers in the world, as itis mostly diagnosed at a late stage when the probability of cure is rare. It kills more people than breast, colon and prostate cancers combined[2]. The five year survival rate for all stages combined is only 14%. This has not changed in the past three decades [3].The most common cause of lung cancer is long term exposure to tobacco smoke. Cancer develops when cells inside the lungs multiply at an uncontrollable rate. These abnormal tissue masses are called tumors. Tumors are either non-cancerous (benign) or cancerous (malignant) [4]. This cancerous growth may lead to metastasis, invasion of adjacent tissue and infiltration beyond the lungs. Early detection and treatment of lung cancer is important in order to improve the survival rate of cancer patients. Imaging plays a vital role in the diagnosis of lung cancer, with the most common modalitiesincluding chest radiography, CT, PET, MRI [5, 6].In recent times, Computed Tomography (CT) is the most effectively used for diagnostic imaging examination for chest diseases such as lung cancer. The volume and the size of the medical images are progressively increasing day by day. Therefore it becomes necessary to use computers in facilitating the processing and analyzing of those medical images. With the development of computer, computer-aided diagnosis (CAD) has become one of the major research subjects in medical imaging. Image processing algorithms and techniques are applied on the images to clarify and enhance the image and then to separate the area of interest from the whole image. The separately obtained area is then analyzed for detection of nodules to diagnose the disease [6, 7].The goal of image segmentation research is to increase the reliability, accuracy, precision, and to reduce the computational cost of the algorithms. Image segmentation is the process of dividing an image into distinct regions that altogether cover the whole image.The main purpose of the segmentation process is to get more information in the region of interestin an image which helps in annotation of the object scene [8].The work of the edge detection decides the result of the final processed image.

II. METHODOLOGY

The initial stage of the proposed Computer Aided Diagnosing (CAD) techniques is the extraction of lung region from the CT scan image (Fig 1).

The next step of the algorithm aims to attenuate noise without blurring the images. A 2-dimensional median filter was applied using the 'medfilt2' function in Matlab. Each output pixel contains the median value in the 5-by-5 neighborhood around the corresponding pixel in the input image. 'Medfilt2' pads the image with zeros on the edges, so the median values for the points within 3 pixels of the edges may appear distorted.

After that we applied a segmentation algorithm which segments the desired part of image, in this case the tumor which we want to detect (Fig 1). Image Segmentation is a process of partitioning an image into multiple regions or sets of homogenous pixels.

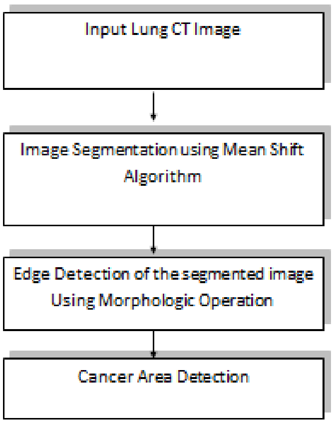

Fig. 1 Flow chart of Proposed method

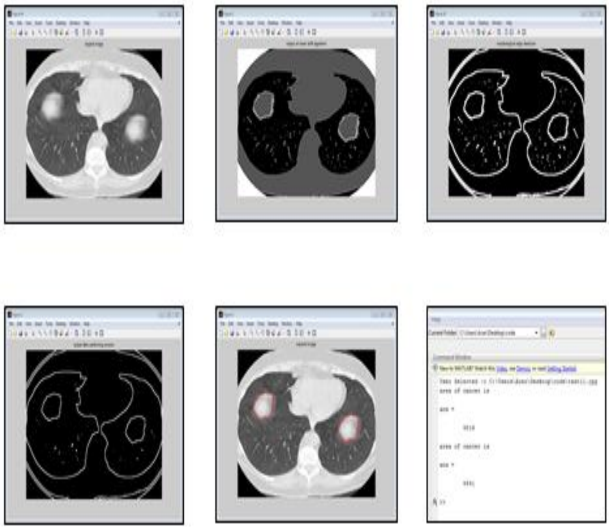

Fig. 2 (a) Original CT image (b) Output after Mean Shift (c) Output after Dilation (d) Output after Erosion (e) Masked image (f) Area of Cancerous nodule

To segment the image we have used the Mean shift algorithm (Fig 2b).Mean shift segmentation is based on the fact that pixels in the same region share some similar modes. By including both spatial position and range as features, mean shift takes into account both the geometrical closeness and the photometric similarity of image during image filtering and segmentation[9]. After segmentation of abnormal region using mean shift we then applied a series of morphological operations (Fig 2c, 2d).

After the application of morphology, we can easily distinguish between the source image which we take as input and the result image which comes as output. The output image clearly shows the tumor part with less blurring and noise. The masked image shows the cancer area with red outline (Fig 2e), along with this area of cancerous nodule is also calculated(Fig 2f). The calculated area shows the size of nodule, which estimates the severity of nodule. The execution time of image processing is also calculated and compared with the other traditional methods which show the proposed algorithm runs faster (Fig 3).

Table 1: Evaluation result of various segmentation methods

Subject	CT Slice	Normalised Cuts	Graph	Region Growing	Water Shed	Markov random field	Mean Shift	Proposed algorithm	
		Time s	Time s	Time s	Time s	Time s	Time s	Time s	Accurac %
W0004	97	497.60	1.20	25.35	31.50	6.10	3.40	0.41	91
	122	436.70	1.30	22.93	49.20	5.40	3.35	0.39	92
W0005	109	406.00	1.15	19.56	36.20	4.90	2.95	0.29	91
	137	415.10	1.35	21.86	45.10	5.70	3.10	0.34	94
W0006	128	443.90	1.15	22.46	33.70	6.40	2.81	0.44	83
	153	478.70	1.30	21.52	37.20	5.80	2.75	0.31	95
W0010	115	543.10	1.20	20.15	39.60	5.60	2.70	0.41	84
	144	438.00	1.30	18.98	42.60	5.20	2.70	0.31	89
	202	469.10	1.05	16.28	41.70	5.60	2.76	0.43	95
Average		470.73	1.30	20.68	38.60	5.60	2.99	0.37	90.4

The accuracy of images is also calculated by comparing them with ground images. The table (Table 1) shows accuracy of proposed system is approx. 90%.

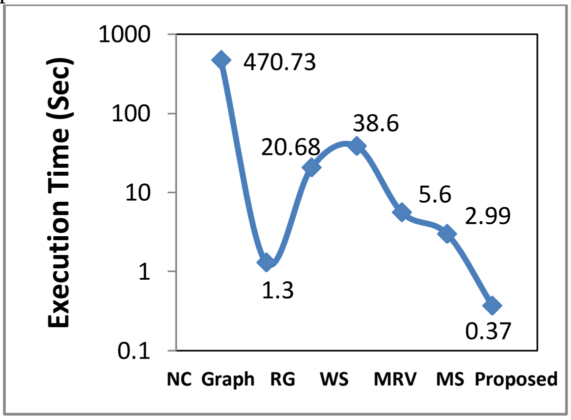

Fig. 3 Execution time in log linear

III. CONCLUSION AND FUTURE WORK

The proposed algorithm when compared with another segmentation technique gives the faster response. Hence it has faster execution time. It detects the affected area of lungs accurately. Average accuracy of the proposed algorithm comes out to be approx. 90%. Proposed algorithm found to be faster and accurate method. It can be further improved by adding neural training methods. This is a more challenging problem since the other organs, liver, kidneys, intestines and so on, have an intensity that is more equal to flesh, muscles and blood in CT images.

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