Mass Segmentation Techniques For Lung Cancer CT Images

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***Abstract*—** Mass segmentation methods are commonly used nowadays in modern diagnostic centers and research centers working in the field of lung cancer detection and diagnosis. We have implemented k-means and fuzzy cluster means (FCM) techniques for mass segmentation of lung CT images. The methods were compared in terms of area, perimeter and diameter. FCM outperforms K-means in terms of better detection of lung cancer area and effective values of dimensional features of lung cancer as compared to K-means method.

Keywords- *Computed tomography (CT), Fuzzy c-means (FCM), K-means.*

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I. INTRODUCTION

Presently low dose CT is the core interest area for detection of lung cancer. Mass region detection is a rising research work field that has received continuous focus in the research group over the past decades. Image segmentation is a process to partitioned digital image into several regions [1-9]. Each of the pixels in the region has same characteristics like color, intensity, texture etc. For early diagnosis of lung abnormalities CT images are widely used by radiologist to detect cancer nodule with some feature such as area, diameter and size [13].The efficient segmentation algorithm provides good accuracy and higher decision confidence value to the radiologist to make better remark. There are several issues related to image segmentation that required detailed review of literature. The most important part of image segmentation is to detect the proper area of mass by selecting suitable method for isolating different object from the background. The two existing clustering techniques have been used for segmentation purpose but for actual segmentation some morphological operation has been used over clusters. The performance of these two techniques is also evaluated and results are screened.
Judice et al. (2013) presented an automated computer added diagnosis (CAD) system in which wiener filter is used to remove noise. Hidden Markov Model algorithm was proposed which increase the confidence level of diagnosis and taken less time also[5].
Maivizhi et al. (2013) used K-means and Fuzzy c-means algorithm to find out cancer affected gene and proposed modified fuzzy c-means algorithm to grasp cancerous nodule. An experimental system has been implemented and tested to demonstrate the effectiveness of proposed method on the basis of parameter such as no of cluster, time, space and performance calculation and cluster evolution [9]. Niranjana et al. (2014) worked on Neural fuzzy Network (NFN) and a Fuzzy c-mean (FCM) clustering algorithm for segmenting the early stage of lung cancer. A thresholding technique as a pre-processing step in all images to extract the nuclei regions was applied, because most of the quantitative procedures are based on its nuclei feature. This thresholding algorithm had succeeded in extracting the nuclei regions. Moreover, it succeeded in determining the best range of thresholding values. The NFN and FCM methods are designed to classify the image of N pixels among M classes and tested over many color images, and NFN has shown a better classification result than FCM [11]. Kumar et al. (2013) compared Artificial Neural Network (ANN), Fuzzy C-Mean (FCM) and Fuzzy Min-Max Neural network (FMNN) which is very effective and helpful in cancer diagnosis for its several advantages. The motive behind that the fault tolerance, flexibility, non linearity are the factors of artificial neural network. FCM provides finest findings for overlapped data set; data point may be connected with more than one cluster centre. Non-linear separability, soft and hard decision, less training time, online adaptation is the advantages of FMNN. The classification methods are applied to both FMN and FCM on the X-ray 130 cancerous and noncancerous datasets available. Hence using FCM and FMNN to diagnose lung cancer is good[12].
Jaffer et al. (2009) proposed a method by using Fuzzy c-mean (FCM) and morphological techniques for detection of tumor from lung computed tomography (CT) images. Initially, the automated segmentation of lungs has been done using fuzzy. Region of interests (ROIs) have been extracted by using 8 directional searches slice by slice and then 3D ROI image have been constructed. A 3D template has been constructed and convolves with the 3D ROI image. Finally FCM have been used to extract ROI that contain nodule. The technique was tested against the 50 datasets of different patients received from Aga Khan Medical University, Pakistan and Lung Image Database Consortium (LIDC) dataset [22]. Patel et al. (2010) developed an adaptive k means clustering algorithm for mammographic images segmentation for detection of breast cancer at early stage. The feature extraction is performed with the data base of 150 breast cancer images taken from BSR

APPOL with the parameter such as number, color and shape of object[23].

Fatma et al. (2011) presented Hopfield Neural Network (HNN) and a Fuzzy c-mean (FCM) clustering algorithm, for segmenting sputum color images for detection of lung cancer in early stages. The above methods are designed to classify the image of N pixels among M classes. They used 1000 sputum color images to test both methods, and HNN has shown a better classification result than FCM, the HNN succeeded in extracting the nuclei and cytoplasm regions [33]. Kaur et al. (2015) reviewed two methods i.e. Neural Network (NN) and Fuzzy c-mean Clustering Algorithm for sputum color images for early diagnose of lung cancer. They compared these two methods with their advantage and disadvantage and conclude that Fuzzy c-mean (FCM) clustering algorithm is not good at low intensity variations [35].

II. PROPOSED METHODOLOGY

The proposed method follows several steps which include taking input image for pre processing for removal of noise and enhance the contrast of input image for better segmentation

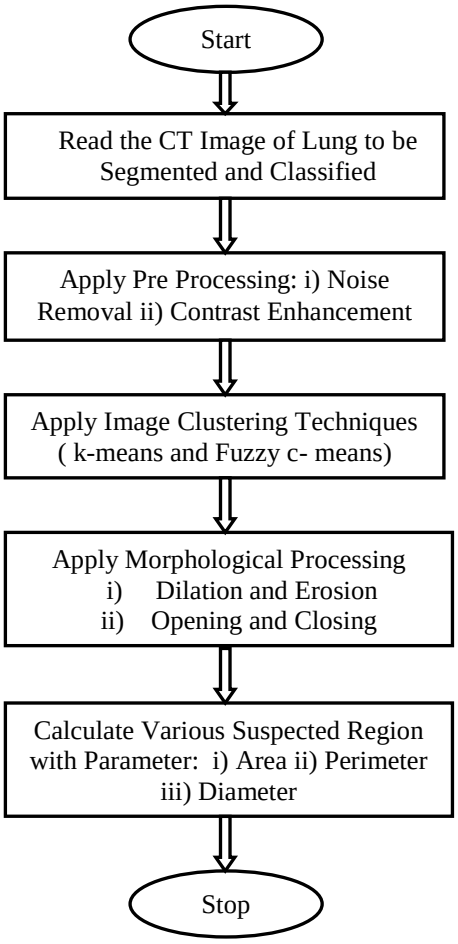

Fig. 1: Flow diagram of proposed system

using various clustering techniques such as K-means and Fuzzy c-means. To find out accurate mass region process such as binary, dilation, erosion, opening and closing are performed step by step on each image. Finally, evaluate parameter like area, diameter and perimeter for comparison of better method. The flow diagram of proposed system has shown in Fig. 1.

III. RESULTS AND DISCUSSION

In this work we have compared two clustering techniques K-means and FCM for better lung mass segmentation in CT images that are used in CAD system. Both the methods are compared with several morphological operation and from the Fig. 2 it has been notice that the K-means techniques gives little bit smooth rounding edges for suspected nodule whereas FCM bordered more accurately because cancer nodule has not any specific size and somehow in zigzag pattern. The parameter such as area, perimeter and diameter calculated by FCM are more accurate as compare to K-means for each nodule. These parameters calculating by K-means is lesser due to smooth surfacing in nodule but FCM calculate these parameter values for each nodule efficiently which helps to further classify the nodule for T staging. Both the techniques gives prominent result but FCM is better for marking proper suspected area in case of single and multiple nodule detection in CT image of lung The comparative study of K-means and Fuzzy c-means algorithms in terms of several parameters such as area, diameter and perimeter has been evaluated. Experimental data have been consisting of more than 50 images and comparative results of 6 images are shown in Table 1.

Table 1: Comparison of Segmentation Techniques

Image No.	Parameter	K-means (pixel)	FCM (pixel)
cp1	Area	1839	1891
	Perimeter	162.8	182.5
	Diameter	48.4	49.1
cp2	Area	919	938
	Perimeter	114.3	116.1
	Diameter	34.4	34.6
cp3	Area	507	513
	Perimeter	91.3	89.6
	Diameter	25.4	25.6
cp4	Area	245	277
	Perimeter	55.7	59.7
	Diameter	17.7	18.8
cp5	Area	521	532
	Perimeter	90.1	94.3
	Diameter	25.8	26
cp6	Area	914	918
	Perimeter	190.5	189.3
	Diameter	34.1	34.2

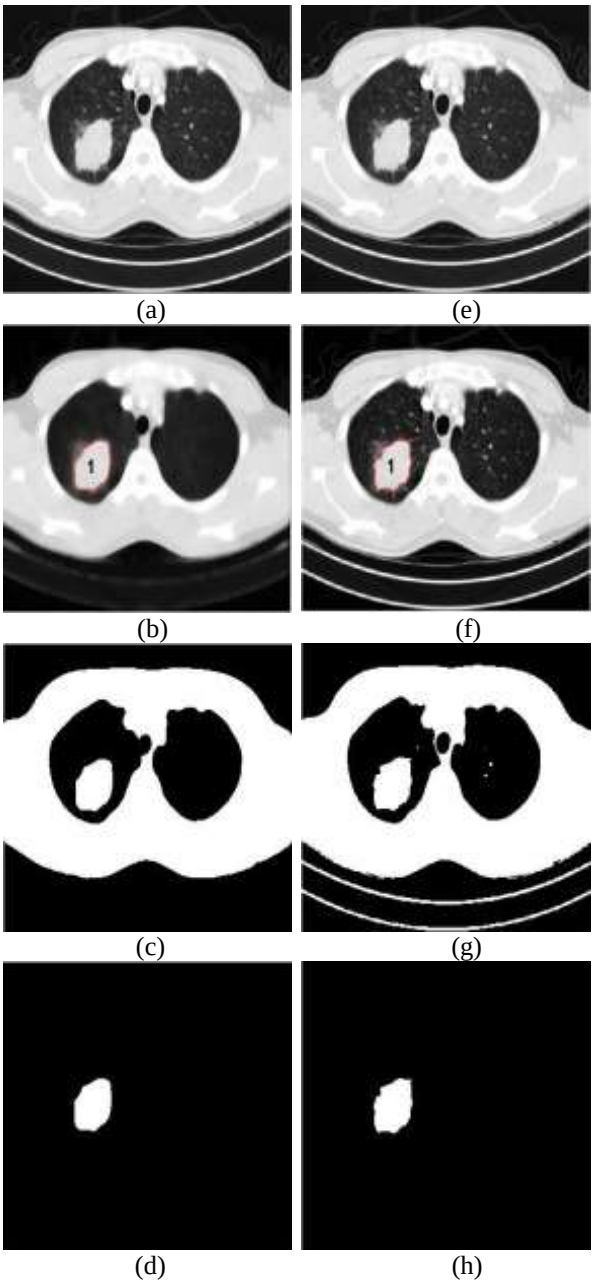

Fig. 2 Result of K-means (a) Original image (b) Region of Interest (c) Binary image (d) Segmented Image Result of FCM (e) Original image (f)Region of Interest (g) Binary image (h) Segmented Image

IV. CONCLUSION

This work presents the better CAD system for automatic detection of lung nodule using segmentation techniques like k-means and fuzzy c-means (FCM) and carried out with some morphological operation for proper extraction of affected lung area. These algorithms tested over 50 images and found FCM is better than k-means in all respect for efficient detection of mass region inside lung CT images.

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