A Survey on Noise Reduction and Segmentation Techniques in CT DICOM Images

Rashmi Kulkarni [1], Bhavani k[2]

[1]*Dept. of Information Science and Engineeering, DSCE, Banglore, Karnataka, India*
[2] *Assistant Professor, Dept. of Information Science and Engineeering, DSCE, Banglore, Karnataka, India*

Abstract - *Now a day, Image processing has become booming field for research. In that, Medical Image Processing is taking lot of importance. Diagnosing a patient at a correct time, with correct results is very challenging. CT images which are used in medical diagnosis may contain noise. The physician may be interested in particular parts of organs for diagnosing. The segmentation of medical images is the one of the techniques. Before doing segmentation on medical images, removing the noise in those images is very important. This paper discusses some of the techniques used for preprocessing and segmentation of DICOM images.*

***KEY WORDS*: Medical image processing, Image preprocessing, filters, Segmentation algorithms, CT images, Classifiers.**

1.INTRODUCTION

The CT medical images are complex in nature. Segmentation of CT images is the predecessor for image analysis. Segmenting particular part of organs in which we are interested, helps to indentify the abnormalities in the patient's organ. Before segmenting the image, removal of the noise present in the image is important. The medical images get noise in it, while acquiring the image from the scanner. In acquiring the Computed Tomography (CT) images, the patients are moved horizontally along the vertical ring, which exposes x-rays on patient's body. The sensitive plate fixed at the bottom, absorbs the scanned image of the patient. As the result the cross sectional image of the patient's organ is acquired.

The unwanted noises such as Salt and pepper noise, Speckle noise, Poisson noise [15] are present in images. These noises will reduce the image quality and cannot identify the abnormality in the images. To remove these noises, Diffusion filter, Adaptive filter, Anisotropic filter, Wavelet filter, Gabor filter, Morphological filters are used.

The DICOM images are the medical images. They are present in .dcm format. Each DICOM image contains metadata. The various tags and subtags are present in each image files.

2. LITARATURE SURVEY

Here, survey of some techniques used for preprocessing of CT images and its segmentation techniques are discussed.

Suren Makaju et al. [1] proposed a model to detect cancer nodules in CT lung images. The proposed system consists of preprocessing of images to remove noise and segmentation techniques. In this model the CT DICOM images are converted in to JPEG images. In preprocessing stage, the median and Gaussian flitters are used to smooth the image and remove speckle noise from image. Watershed algorithm is used for segmentation. Feature extraction is done on the images. Used machine learning method called Support Vector Machine (SVM) [1] as classifier to differentiate nodule as malignant or benign .

Hasan Koyuncu et al. [2] proposed BFO model for image enhancement before abdominal organ & tumor segmentation. At first, the denoising process is realized by Block Matching and 3D Filtering (BM3D) algorithm for elimination of Gaussian noise stated in arterial phase CT images. At second, Fast Linking Spiking Cortical Model (FLSCM) is used for removing the internal fat tissue. At last, Otsu algorithm is processed to remove the redundant parts within the image. Thus new model name got name as BFO that is combination of these three steps. According to results, it is seen that proposed tool obtains the best PSNR and SSIM values in comparison with two steps of pipeline (FL-SCM and BM3D & FL-SCM). Consequently, BM3D & FL-SCM & Otsu (BFO) ensures a clean abdomen particularly for segmentation of liver, spleen, pancreas, adrenal tumors, aorta, ribs, spinal cord and kidneys [2].

Jiayong Yan et al. [3] proposed a promising method to segment the liver metastases on contrast-enhanced sequential CT images. This proposed method uses marker-controlled watershed transform for segmentation and fuzzy connectedness algorithm to determine the internal and external markers for the liver metastasis in CT images. It is a semiautomatic method [3].

Kalyani C S et al. [4] proposed method for segmentation on region based method by using K-means clustering. Two datasets of male pelvic region CT images without contrasted and one dataset with contrast has collected. The averaging is done on images, followed by morphological operations-convex hull, opening, closing [4].

Ashwani Kumar Yadav et al. [5] proposed a model for segmenting Brain MRI and CT Angiography images. The preprocessing is done by several steps such as image acquisition, type conversion, image enhancement, geometric transformation, filtration, morphological transformation.

The preprocessed images are segmented by thresholding method. The results are calculated by two parameters .That is completeness and other one is correctness [5].

M.Jayanthi [6] compared the results of segmentation algorithms for liver CT images. The DICOM images are converted into gray level images. Median filtering technique is used to remove unwanted noise in images to get accurate results. Histogram Techniques, seeded region growing method, connected component algorithm, NS based [6] thresholding algorithms are the segmentation algorithms used for liver images. The dice similarity values are compared and found that the NS based thresholding algorithm works better for liver CT images than any other. And found that computation time is lesser than other algorithms.

Shaimaa A.Elmorsy et al. [7] proposed method for segmentation of liver tumor. The proposed method uses the thresholding process, region growing process, morphological operations. Morphological filtering is done by erosion technique and smoothing is done for CT liver images. The entropy filter is used to get the better overlapped images. The images are compared by using entropy filter with different sizes of structured elements [7]. Best fit is chosen and segmentation technique is applied. The segmented images of proposed system and by using median filtering and segmentation techniques method are compared. The result shows the proposed method works better.

Wei He et al. [8] proposed method for extracting abdominal aorta from CT images. Vessel enhancing diffusion filters are used to highlight the vessels and three-dimensional region growing algorithm to segment [8] the part. The morphological operations like opening and closing are done on images. The results show that it works better for 3D CT images.

P.Arjun et al. [9] proposed an improved region growing algorithm to enhance the segmentation of the liver from abdominal CT images [9]. Denoising of images is done by applying Gaussian filter to remove Gaussian noise. The high gray scale parts of images are removed by thresholding segmentation. Image contrast is improved by non-linear mapping technique. K-means clustering algorithm [9] is used to classify the dataset. An improved region growing algorithm [9] partitioned the image from overlapped image to non-overlapped image. The results are compared with traditional region growing algorithm [9] and K-means clustering [9]. It is found that an improved region growing algorithm [9] is having high accuracy of 97.04% where as traditional region growing is 86.03% and K-means clustering [9] is 87.52%.

SL.NO	AUTHORS	METHODS USED FOR PREPROCESSING	METHODS USED FOR SEGMENTATION	ADVANTAGES/ DRAWBACKS	EFFICIENCY
1.	Suren Makaju et al. [1]	a. Median and Gaussian Filter for noise removal	a. Watershed algorithm for segmentation b. Machine learning method by using Support Vector Machine (SVM) [1] as classifier.	1. Proposed model [1] detects the cancer with 92% accuracy which is higher than current model and classifier has accuracy of 86.6% . 2. Proposed model does not classify into different stages as stage I, II, III, IV of cancer.	92% accuracy in detecting cancer nodules as malignant or benign
3.	Jiayong Yan et al. [3]		a. Marker-controlled watershed transform b.Fuzzy connectedness algorithm	1. Even for the images disturbed by other organs or tissues, the approximate results can be obtained without any other special operations. 2. The algorithm only requires an initialization stoke given manually inside the target liver metastasis.	Data set of 30 liver metastasis CT images randomly selected from 10 patient cases. The overall area overlap ratio is 0.83±0.04
4	Kalyani C S et al. [4]	a. Averaging b. Morphological operations such as convex hull, opening, closing.	a. K-means clustering	1. The bounding box representation of ROI will decrease the processing time for volume rendering	The time taken for the segmentation was 10.072s. Rendering using maximum intensity projection took 2.19s. ROI was

					saved in the bounding box representation , the rendering time reduced to 1.97s.
5	Ashwani Kumar et al. [5]	a. Image acquisition, type convertion, image enhancement, geometric transformation, filteration , morphological transformation.	a. Segmentation by thresholding technique	The proposed method gives the result by correctness and completeness.	The proposed method gives 2% more in completeness and 1% more in correctness than histogram equalization technique
6	M.Jayanthi [6]	a. Median filter for noise removal. b. Type conversion c. Histogram Techniques	a. Seeded region growing method b. Connected component algorithm[6] c. NS based thresholding [6] algorithms [6]	The results are compared and found out that NS based thresholding algorithm [6] works better than others.	The dice value of NS based thresholding algorithm is having 0.1 dice coefficient more than LCCA and 0.2 more than SRG.
7	Shaimaa A.Elmorsy et al. [7]	a.Morphological filtering – erosion and smoothing b.Entropy filtering	a.Thresholding process b.Region growing process[7]	RG segmentation with adaptive SE size and morphological operations gives good results compared with manual segmented liver [7].	The average error percent of proposed method is 5.01037 for 10 test cases studies instead of 14.61807 as in median filtering method.[7]
8	Wei He et al. [8]	a. Vessel enhancing diffusion filter. b. morphological closing and opening operations	a. Three dimensional region growing algorithm	1. The proposed method works better in segmenting abdominal aorta for 3D CT images. 2. The selection of seed point is manual, it would be best if it is automated selection of seed point.	The ratio of segmented result is 47.0% to 78.2%.
9	P.Arjun et al. [9]	a. Denoising	a.Thresholding b. non-linear mapping c. K-means clustering d. an improved region growing algorithm[9]	1. It is found that accuracy of proposed system is high. 2. In denoising, this system didn't remove speckle noise.	The accuracy is improved up to 97.04%.

Table -1: Literature Survey

3. CONCLUSIONS:

By analyzing the results of various works for segmentation of CT medical images, found that preprocessing [10] for medical image is necessary to get high accurate results. The Gaussian noise and speckle noise are common is image acquisition of DICOM [12] CT images. By seeing the above results it is found that before going for segmentation technique, it is very necessary for denoising images by using Gaussian filter, median filter. The segmentation techniques [11][13][14] like watershed algorithm gives the accuracy of 92% and Thresholding with accuracy of 97.04%. The classifying techniques like SVM gave the best results.

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