Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 3, Issue. 3, March 2014, pg.371 – 378

REVIEW ARTICLE

Review of Image Processing Techniques for Automatic Detection of Tumor in Human Liver

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Abstract- ***The review paper describes the various image processing techniques for automatic detection of tumor in human liver. Without a healthy liver a person cannot survive. It is a life threatening disease which is very challenging phenomenon for both medical and engineering technologists. The chances of survival having liver tumor highly depends on early detection of tumor and then classification as Malignant (cancerous) and Benign (non-cancerous) tumors. In this paper image processing techniques for automatic detection of brain are discussed which includes image acquisition, preprocessing and enhancement, image segmentation, classification and volume calculation steps.***

Keywords- Image Preprocessing and Enhancement; Segmentation; Benign; Malignant; Classification

I. INTRODUCTION

The incidence of liver tumor has increased many folds. Estimated liver cancer death per 1000 in men is 14.0 and in women is 11.5 in 2010.Medical image processing and analysis is one of the best techniques to detect the tumor. In past years, invasive methods are used for diagnosis any disease like tumor or cancer. But now a days medical imaging aims on non-invasive methods for diagnosis of tumor. Various computer-aided diagnostic (CAD) tools are designed and developed for liver tumor. Various types of imaging technologies based on non-invasive approach are CT scan, MRI, X-Ray, ultrasound and liver scans. These tests not only determine the size and location of the tumor but also determine if cancer has spread to other parts of the body.

The liver is the largest glandular organ in the body and performs many vital functions to keep the body pure of toxins and harmful substances. It is a vital organ that supports nearly every organ in the body in some facet. The liver receives about 1.5 quarts of blood every minute via the hepatic artery and portal vein.

A liver tumor is an abnormal growth or mass found in the liver. Such tumors can be secondary or primary tumors. Tumors of the liver- a large, reddish organ in the abdomen that produces proteins and digestive juices, stores energy and removes toxins from the body- can be benign(not cancerous) or malignant(cancerous).

Tumors are groupings of abnormal cells that cluster together to form a mass or lump. When a tumor develops in the liver, the organ is unable to function properly. Tumors that originate in the liver may be benign and malignant known as primary tumors and the tumor that has spread to the liver from its original source of origin in another part of the body is secondary tumor. More than 40000 persons per year in the world are suffering from liver tumor.

For diagnosis fully automatic based histogram thresholding segmentation techniques are applied on images of liver. Then classification techniques are applied on segmented images to classify tissue into two types normal and abnormal. Then abnormal tissue's image is further investigated for extracting useful information from segmented image with the presence of some noises. Then volume calculation is carried out to identify its size.

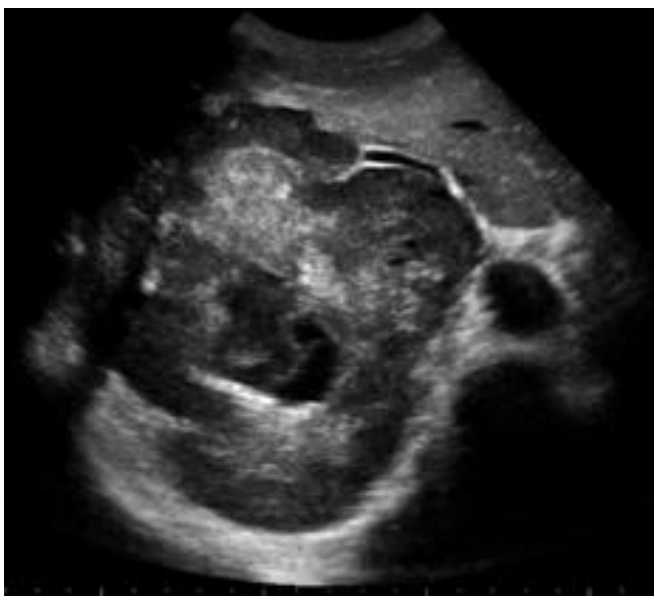


Fig: Malignant (cancerous)

II. IMAGE PROCESSING TECHNIQUE

Image processing is a method to convert an image into digital form and perform some operations on it in order to get an enhanced image or to extract some useful information from it.

Image processing basically includes the following three steps.

- Importing the image with optical scanner or by digital photography
- Analyzing and manipulating the image that includes data compression and image enhancement and spotting patterns
- the last is the output in which result can be altered image

III. LITERATURE REVIEW

Chung-Ming Wu, et al. [1] proposed a texture feature called Multiresolution Fractal (MF) feature to distinguish normal, hepatoma and cirrhosis liver using ultrasonic liver images with an accuracy of 90%.

Yasser M. Kadah, et al. [2] extracted first order gray level parameters like mean and first percentile and second order gray level parameters like Contrast, Angular Second Moment, Entropy and Correlation, and trained the Functional Link
Neural Network for automatic diagnosis of diffused liver diseases like fatty and cirrhosis using ultrasonic images and showed that very good diagnostic rates can be obtained using unconventional classifiers trained on actual patient data.

Aleksandra Mojsilovic, et al. [3] investigated the application and advantages of the non-separable wavelet transform features for diffused liver tissue characterization using B-Scan liver images and compared the approach with other texture measures like SGLDM (Spatial Gray Level Dependence Matrices), Fractal texture measures and Fourier measures. The classification accuracy was 87% for the SGLDM, 82% for Fourier measures and 69% for Fractal texture measures and 90% for wavelet approach.

E-Liang Chen, et al. [4] used Modified Probabilistic Neural Network (MPNN) on CT abdominal images in conjunction with feature descriptors generated by fractal feature information and the gray level co-occurrence matrix and classified liver tumors into hepatoma and hemangeoma with an accuracy of 83%.

Pavlopoulos, et al. [5] proposed a CAD system based on texture features estimated from Gray Level Difference Statistics (GLDS), SGLDM, Fractal Dimension (FD) and a novel fuzzy neural network classifier to classify a liver ultrasound images into normal, fatty and cirrhosis with accuracy in the order of 82.7%.

Jae-Sung Hong, et al. [6] proposed a CAD system based on Fuzzy C Means Clustering for liver tumor extraction with an accuracy of 91% using features like area, circularity and minimum distance from liver boundary to tumor and Bayes classifier for classifying normal and abnormal slice.

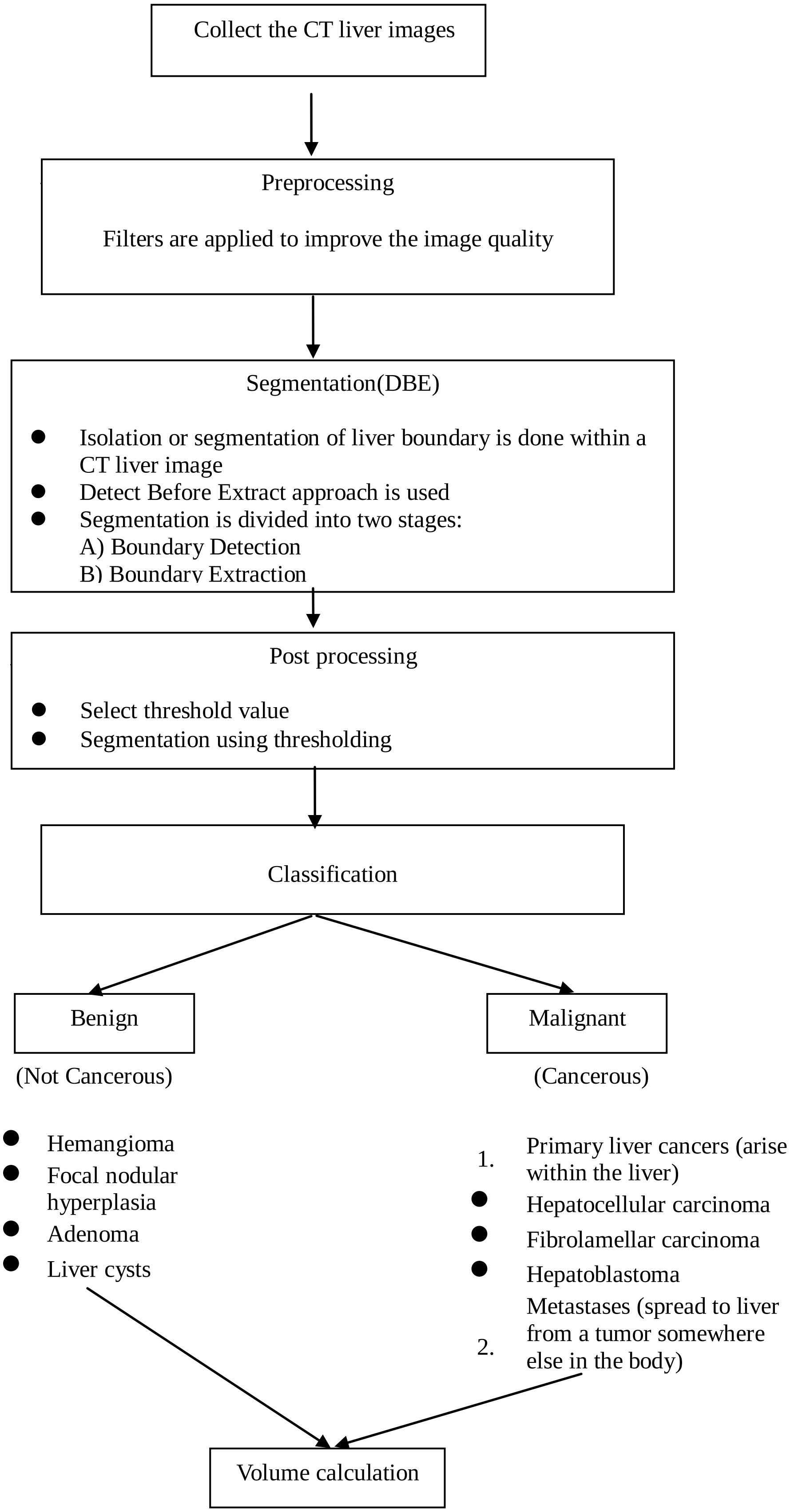
The CAD system proposed by Gletsos Miltiades, et al. [7] consists of two basic modules: the feature extraction and the classifier modules. In their work, region of interest (liver tumor) were identified manually from the CT liver images and then fed to the feature extraction module. The total performance of the system was 97% for validation set and100% for testing set.

Haralick transform and Hopfield Neural Network were used to segment 90% of the liver pixels correctly from the CT abdominal image by John. E. Koss, et al. [8]. However, texture based segmentation results in coarse and block wise contour leading to poor boundary accuracy.

Chien-Cheng Lee, et al. [9] identified liver region by using the fuzzy descriptors and fuzzy rules constructed using the features like location, distance, intensity, area, compactness and elongated-ness from CT abdominal images.

IV. METHODOLOGY

The sequence of operations for detection of tumor in CT images of liver consists of various steps like preprocessing, segmentation(DBE), feature extraction and classification of tumor. These are shown in following figure:


Collect the CT liver images
Preprocessing
Filters are applied to improve the image quality
Segmentation(DBE)
Isolation or segmentation of liver boundary is done within a CT liver image
Detect Before Extract approach is used
Segmentation is divided into two stages:
A) Boundary Detection
B) Boundary Extraction
Post processing
Select threshold value
Segmentation using thresholding
Classification
Benign
Malignant
(Not Cancerous)
(Cancerous)
Hemangioma
Focal nodular hyperplasia
Adenoma
Liver cysts
1. Primary liver cancers (arise within the liver)
Hepatocellular carcinoma
Fibrolamellar carcinoma
Hepatoblastoma
2. Metastases (spread to liver from a tumor somewhere else in the body)
Volume calculation

a. Preprocessing

Preprocessing of liver CT image is the first step in our proposed technique. Preprocessing of an image is done to reduce the noise and to enhance the image for further processing. The purpose of these steps is basically to improve the image and the image quality to get more surety and ease in segmenting the liver. Steps for preprocessing are as follows:

- Image is converted to gray scale.
- A 3x3 median filter is applied on liver CT image in order to remove the noise.

b. Liver Segmentation

After enhancing the liver CT image, the next step of our proposed technique is to segment the liver region from liver CT image. Segmentation is done to separate the image foreground from its background. Segmenting an image also saves the processing time for further operations which has to be applied to the image. We have used segmentation using a global threshold in order to segment the liver CT image. Afterwards some morphological operations are applied on the image to obtain the final segmented liver region.

c. Postprocessing

After segmenting the liver region from liver CT image, several postprocessing operations are applied on the image to enhance the liver region so that area of focus can be clearly highlighted. These postprocessing operations include adaptive histogram equalization, gaussian smoothing and gray level transformations.

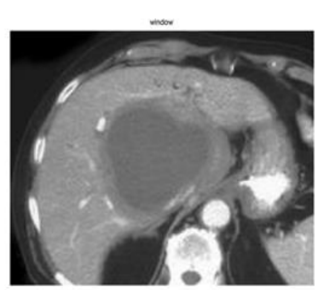
d. Classification

Classification technique classifies the tissue into two classes namely benign (not cancerous) and malignant (cancerous).

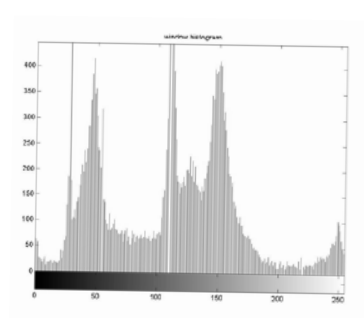
V. RESULTS

As a part of survey of various image processing techniques, the author has implemented some of the techniques like preprocessing, segmentation, feature extraction and result are as follows:

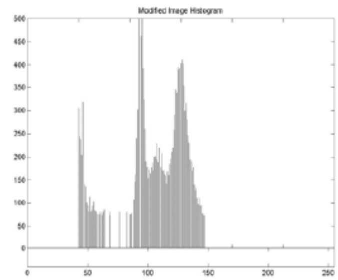
a) CT abdominal image



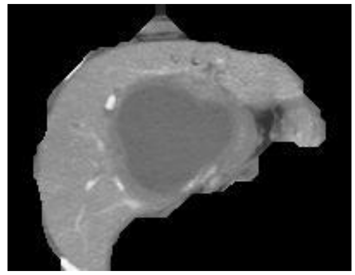
b) Window slice



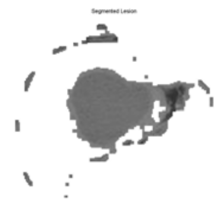
c) Histogram of window slice



d) Histogram after threshold



e) Segmented Liver



f) Segmented Tumor

VI. CONCLUSION

The proposed system is used to segment the tumor with considerable satisfaction. Results are evaluated with radiologists. The proposed system can be extended for other types of images or for other classes of liver diseases, provided that the feature vectors are reevaluated and the neural networks are retrained. This can be helpful for teaching and for fresher to improve their diagnostic accuracy. In this paper liver segmentation and enhancement is done using CT images. The proposed method segments the liver using global threshold and then by identifying the largest area. The proposed method is invariant in terms of size and shape of liver region. Experimental results show that our method performs well in enhancing, segmenting and extracting liver region from CT images.

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