

# Liver Tumor Segmentation and Feature Extraction using Segmentation based Fractal Textural Analysis Method (SFTA)

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**Abstract**— Late diagnosis of Liver cancer increase the mortality rate. So detection at its early stage is very important. Here non-invasive imaging techniques are used for the segmentation of liver cancer. Automatic segmentation of liver tumor from abdominal CT image is performed in this work. Adaptive threshold method is used to extract the liver and tumor from abdominal image. Feature extraction is the key factor in classification of extracted tumor into different diseases. SFTA (Segmentation based Fractal Textural Analysis) is an emerging technique to extract relevant features for automatic diagnosis of liver diseases. It is a fractal based method. This method provides better segmentation of liver tumor as well as a feature vector of the input image is obtained, which can be used for classification later.

**Index Terms**— Abdominal CT scan, Segmentation, Adaptive thresholding, Feature extraction, SFTA (Segmentation based Fractal Texture Analysis)

## I. INTRODUCTION

Liver is the largest organ in human body. As it is made up of different tissues, it is more prone to be affected by different types of tumor. Referring to world cancer statistics report, liver tumor is sixth most common and second largest leading cause of death factor of the world. Liver cancer is also known as primary hepatic cancer and hepatic cancer. Main cause of liver cancer is cirrhosis due to hepatitis and alcohol usage. For extracting feature vector from the image three different diseases such as HCC (Hepatocellular carcinoma), Hemangioma and Hepatic adenoma. HCC is malignant tumor (cancerous), that develop in the setting of cirrhosis or chronic liver disease. Hemangioma is benign tumor (non cancerous). This type of tumor is commonly occur pregnant woman and woman using estrogen replacement therapy. The size of tumor is small. Hepatic adenoma is non cancerous (benign tumor) and the size of tumor is large compared to hemangioma.

Needle biopsy is the gold proof method to detect tumor. Since it catalyzes the growth of liver cancer, non-invasive imaging techniques were preferred by physician. It gives visual representation of interior of a body for clinical analysis and medical intervention. Different types of imaging techniques such as Computed Tomography (CT) scan, Magnetic Resonance Imaging (MRI), Ultrasound scan etc are used for this purpose. In this work we concentrate on CT images and it produce high quality images same as that of MRI images, it is cheaper compared to that of MRI etc.

Segmentation of liver from abdominal CT scan is the critical step, because the intensity values of liver tissues and adjacent tissues have same value. In this work adaptive threshold method is used to extract the liver from abdominal image and same method is used to segment the tumor from the liver. When the input data is very large,

then the input data is transformed to reduced set of features. Transforming the input into a reduced set of features is known as feature extraction. For that SFTA (Segmentation based Fractal Texture Analysis) is used

## II. LITERATURE SURVEY

Several researches are going on in segmentation of tumors. In this work abdominal CT image is used for the extraction of liver. The abdominal image contains several organs. The intensity values of organs are also same. So it is very difficult to do segmentation especially manual segmentation. Manual segmentation causes so many errors, so we go for automatic segmentation process. Various techniques used for segmentation are thresholding, region growing, KNN, Fuzzy C means clustering. In [1] describes that segmentation is based on the anatomical structural details. The main difficulties are constant grey level based segmentation does not produce the required regions. In [2] various morphological operations. Erosion, dilation, opening, closing are explained. Region based technique [3] are done based on the similarity between the pixels, thus only regions are generated. This technique fails to provide the better segmentation. In [4] proposed watershed and gradient vector flow to the detection of brain tumor. One of the main disadvantages in gradient vector flow is that it is very sensitive to noise and produce complex structures. These defects are eliminated when we combine the watershed and gradient vector flow. Several methods are available for segmentation, but these techniques don't give any accurate results. The above methods are very complex, this highlight the necessity of better technique for liver tumor segmentation. In [5] various haralick features are explained. Various Haralick features are homogeneity, correlation, dissimilarity etc. But these

features don't give any accurate result for classification. Hence we go for SFTA [6], a fractal based method for feature extraction. In SFTA, binary images are generated and from each binary image, three parameters - mean, area and fractal dimension - calculated. The extension of the present work is to classify the tumour into different diseases using the extracted feature vector.

### III METHODOLOGY

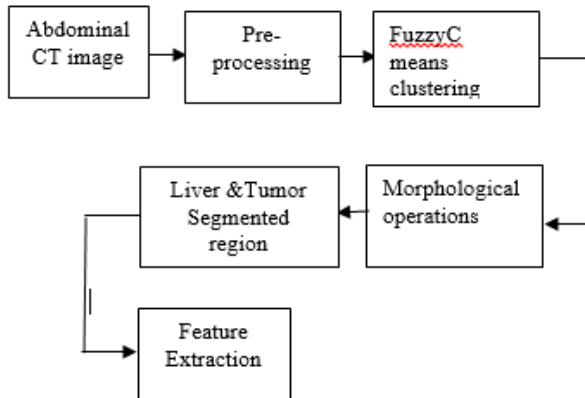


Fig. 1. Block diagram of liver segmentation and Feature extraction

#### A. Abdominal CT Image

Abdominal CT image consist of liver and other adjacent organs like spleen, stomach etc.

#### B. Pre-Processing

Pre-processing means noise removal. An image normally contains noises. These noises cause degradation of the image and leads to information loss. In abdominal CT image liver and other organs are present. So pre-processing of the image is done to enhance the contrast between the organs. This helps segmentation process. Here we use median filter. It is a nonlinear digital filtering technique. The main advantage of this technique is it helps to preserve the edges, while removing noise. It replaces each pixel value with median value of neighboring pixels defined by the mask.

#### C. Segmentation

Segmentation means partition an image from its background. Different techniques are available for segmentation. Here Thresholding technique is used and it creates binary images. In simple threshold method, each pixel in the image is replaced based on threshold value. But fixed thresholding is not feasible in biomedical images, because liver intensity varies depending on the specification of CT machine and other various aspects. So we adopt adaptive thresholding method. In this method threshold value is varied locally through an adaptive process. For this histogram of the CT image is taken, and the highest pitch excluding the background and bone values, represent the middle intensity of the liver region. Certain margin is included within the intensity range of

the liver region to accommodate any variation in the liver region pixels. Based on these processes, the proper intensity range corresponding to the liver region can be adaptively obtained for each slice. The pixels in the determined range of intensity are extracted. Morphological processing helps to preserve the liver structure and remove other organs structure.

#### D. Feature Extraction

When the input data is very large, then it will take more amount of time to execute. So the size of data must be reduced. There are four different feature extraction techniques are there. Stastical based method, Structural based method, Transform based method, Model based method. In structural method it take the structural features of texture, but in stastical approach the structure of texture is not considered, and it take the intensity value of an image. In transform method features are taken on the basis of filter response, In model based method both stochastic and fractal models of textures are taken. Normally stastical approach is used in biomedical image processing. In this method haralick texture features such as contrast, dissimilarity, energy, homogeneity etc are calculated from GLCM (Gray Level Co-occurrence Matrix) matrix. But this technique has so many disadvantages like mean square error is high, execution time is high, accuracy of the classifier is less. So we use fractal based method for feature extraction. Segmentation based fractal textural analysis (SFTA) method is used. SFTA is occur in two main steps. First the input image is decomposed into binary image using two threshold binary decomposition method (TTBD), and then calculate mean, area calculated from each binary image and fractal dimension are calculated from each border image. In TTBD algorithm, first a set of threshold value  $T$  is computed using multilevel otsu algorithm. The value of threshold is choosen that it minimize the intraclass variance and maximize inter class variance. Then otsu algorithm is applied to each image unti the number of threshold,  $nt$  is obtained, where  $nt$  is a user defined parameter. Here we choose  $nt=4$ , because when the value of  $nt$  is large the number of redundant features are also increases, and it increase the complexity and memory requirement. The next step is to decompose the input gray scale image into binary images using otsu algorithm. First select a pair of threshold values from  $T$  and apply to the input image.

$$I(x, y) = \begin{cases} 1, & \text{if } t_L < ROI(x, y) \leq t_U \\ 0 & \end{cases}$$

Thus  $2*nt$  binary images are obtained. From each binary image mean and area are calculated and fractal measurements are calculated from border image. The boundaries of binary images are calculated using the given formula

$$\Delta(x, y) = \begin{cases} 1 & \text{if } \exists(x', y') \in N_8[x, y] : \\ & I_b(x', y') = 0 \wedge \\ & I_b(x, y) = 1, \\ 0, & \text{otherwise.} \end{cases}$$

Fractal dimension is calculated using box counting method. It is similar to perimeter method. First cover the input image with grid and then count how boxes of the grid are covering the image and then repeat the same procedure by reducing the size of boxes, repeat the process until the structure of pattern is obtained. Normally fractal dimension (D) is the slope of line.

$$D = \frac{\log(N)}{\log(r)}$$

N is the number of boxes that cover the pattern, and r is the inverse of box size.

#### IV RESULTS

The images or datasets are collected from Liver atlas. From the available datasets we extract liver region from the abdominal region using adaptive thresholding. One of the image and their result is shown in the below figure 2. Our next aim is to extract tumor from the abnormal liver region, for that above process is repeated, and their results is shown in figure 3



Fig. 2 Original Image

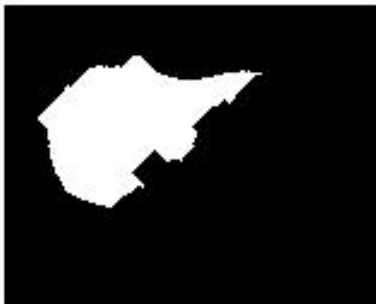


Fig. 3 Binarized liver image



Fig. 4 Segmented Liver

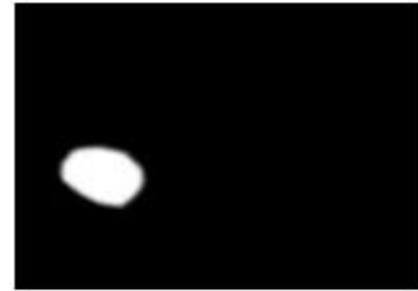


Fig.5 Binarized tumor image



Fig.6 Segmented tumor image

After segmentation of tumor, next step is feature extraction. The SFTA textural features are extracted from the input sample and the resultant feature vector size is 1x21. Each image gives 8 binary images, because  $nt=4$ . From each binary image 3 parameters such as mean, area, fractal dimension are calculated.

#### V CONCLUSION

Today liver cancer is more common, so detection of tumor at its earlier stage is very important. The proposed method provides accurate results to segments the liver from abdominal CT image and to segment tumor from liver image. Morphological operations are used to remove the unwanted areas or to fill useful portions which are used for the further process without changing any shape or structure. Feature extraction helps to reduce the size of image. The results show that our methods performs well in segmentation and feature extraction.

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