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Liver Cancer Detection Using Otsu's Method for Image Processing

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Abstract

According to the World Health Organization, cancer is leading cause of deaths globally. Among all types of cancer, liver cancer has the lowest survivability, with approximately one million deaths each year. It is essential for medical practitioners to decide a suitable treatment for such cancer patients, which requires identification of cancer cells correctly as earliest as possible. For this purpose, image processing technique is used in this paper. Here the input is an MRI image and the output is also an image. The Otsu's method will be used to enhance the MRI image and watershed method will be used to segment the cancer cell from the image. Evaluation and examination of these techniques is done for finest results and highest accuracy. These techniques are also used in medical applications in detection of various diseases.

Index Terms- *Image Processing, Image Enhancement, Image segmentation, Otsu's method, Watershed method, MRI Image, Cancer cell.*

I.INTRODUCTION

Presently, among all types of cancer, liver cancer is the leading cause of millions of deaths each year in the world. Hence to minimize the casualties, the cancer cells should be detected by the doctors and radiologists in the early stages which will provide the possibility of better treatment. Some computer-aided systems like MRI and CT scans are used to scan the body or specific organs. These systems provide the image of an organ to analyze which is immensely hard for doctors due to some imaging parameters. In the purposed method, some image processing operations will be performed on MRI images as it provides high-quality images. The input is an image and the output is also an image. The result of the MRI image will be greatly enhanced by some mathematical succession of the image. For image enhancement, Otsu's method will be used. In the next stage, Assorted denoising methods will be used to remove unwanted noise which will give the best quality of an image for further processing. To segment the object from the background, a Marker-controlled watershed segmentation technique will be adopted. The last stage is feature extraction where wavelet transform will be used, and the output is taken in the form of image.

II. RELEVANCE

Liver cancer is estimated as the most common cancer disease grands human life among both men and women. It is basically classified in two types. First is Primary Liver Cancer which arises in the liver itself and is called as Hepatocellular Carcinoma (HCC) and another is Secondary Liver Cancer where the cancer cell arises from different organ and spread to liver. Due to Hepatoid Cellular Carcinoma (HCC) more than 80% of the cases are affected. It arises from Hepatocytes which are the crucial cells in the liver. For this reason, cancer cells should be identified correctly at early stage.

Surveillance has been the need of time since centuries to be an important aspect in guarding and projecting the material of interest. Over the years, there has been a substantial enhancement in the surveillance technique. Keeping in mind its scope for the future, this paper is implemented. To understand it in a better way and to implement it efficiently, a research on recent developments was carried out.

In [1], authors proposed a Multiresolution Fractal (MF) feature based on texture which helps to distinguish normal, cirrhosis and hepatoma liver using ultrasonic images of liver.

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[2]has sought the advantages and applications of the wavelet transform features for damaged liver tissue depiction using B-Scan liver images and distinguished the approach with other texture measures like Fourier measures, Spatial Gray Level Dependence Matrices and Fractal texture measures.
Furthermore, in [3] authors have studied region growing method which is based on clustering of neighboring pixels of a region that specify some presumption. In this paper, to calculate initial seed the method of Harris corner detector is used. It expansions the computation outlay.
In [4],authors have purposed that image contains two classes of pixels following bimodal histogram. In Otsu method, it separates two classes by calculating the optimum threshold so their inter class variance is minimal or equivalently. It is mainly used for the reduction of a grey level image to a binary image.
According to authors in [5],Otsu method selects the threshold value by minimizing the inter class variance of the two classes of pixels which is separated by the thresholding operator.

III. PRPPOSED METHEDOLOGY

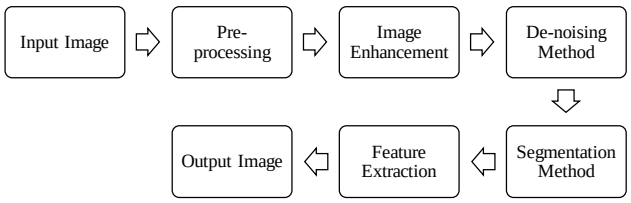

Fig. 1. Block Diagram of Proposed System

A. Image Enhancement:
The results of pre-processed image are greatly enhanced by automotive and accurate classification of image. The image enhancement technique is divided into two parts which are spatial domain technique and frequency domain technique. In spatial domain technique the value of the pixel is changed with respect to the requirement whereas the frequency domain technique deals with the rate of change of pixels which are changing due to spatial domain. It cannot be determined that what type of technique is good for image enhancement. There are many techniques for image enhancement technique out of which we will use Otsu's method.

Otsu's method uses clustering-based technique. It converts greyscale image into binary image. It can roughly said to be one-dimensional method. It searches for the threshold which minimizes the interclass variance. The result gives minimum combined-spread and maximum inter-class variance.

B. De-noising Method:

A fundamental step in image processing is the step of removing various kinds of noise from the image. In this stage, several de-noising methods will be used to get best quality of the image by removing the unwanted noise from the MRI image. The important property of a good image de-noising model is that it should completely remove noise as far as possible as well as preserve edges. The image de-noising technique will be mainly depending on the type of the image and noise in cooperating with it. There have been several published algorithms and each approach has its assumptions, advantages, and limitations. Spatial filters like mean and median filter are used to remove the noise from image.

C. Segmentation Method:

It is an important process for many tasks in image processing. The objective of the process of segmentation is to make the image more useful by changing the representation and simplifying the image due to which it will be easier to analyze the image. The process of segmentation divides an image into region or object. The image processing segments 2D image and it has numerous applications in the field of medical. This may include visualization, estimation of volume of the interest object, detecting abnormalities like tumors, polyps etc. and tissue qualification and much more. There are many techniques for image segmentation out of which we have used Marker-Controlled Watershed Segmentation method. This process enhances the region which indicate the

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presence of the required object. Separating objects of an image is one of the difficult methods which watershed segmentation makes it easier.

D. Feature Extraction:

The last stage includes feature extraction. Image feature extraction is one of the most important technique of image processing. It uses different techniques and algorithm to isolate and detect various shapes and portions of the image. There are numerous techniques to apply this to the image. Wavelet transform is one of the tools for feature extraction. The wavelet transform has a characteristic of analyzing the image with varying unit of resolution and has multi resolution analytic property. The wavelet transform is better than Fourier transform, and short time Fourier transform as it preserves both time and frequency as in Fourier transform.

IV. ALGORITHMS

A. Otsu's Method:

Otsu method was discovered by Scholar Otsu in 1979. It is a very simple and effective thresholding method and hence used globally. This method uses clustering-based technique. It converts greyscale image into binary image and minimizes the interclass variance.

Algorithm:

1. Separate the pixel into two clusters according to the threshold.
2. Find the mean of each cluster.
3. Square the difference between the means.
4. Multiply by the number of pixels.

B. Marker-Controlled Watershed Segmentation:

Marker-Controlled Watershed Segmentation process enhance the region which indicate the presence of the required object. Watershed segmentation is the easiest method to separate objects of an image from background.

Algorithm:

1. Compute a segmentation function. This is an image whose dark regions are the objects you are trying to segment.
2. Compute foreground markers. These are connected blobs of pixels within each of the objects.
3. Compute background markers. These are pixels that are not part of any object.
4. Modify the segmentation function so that it only has minima at the foreground and background marker locations.
5. Compute the watershed transforms of the modified segmentation function.

V. EXPERIMENTATION & RESULTS

Researchers of present day are experiencing that cancer detection is one of the challenging tasks because there is a lack of an accurate model even after a lot of research. The detection is not uni-disciplinary but is a multi-disciplinary task as it is sure of numerous parameters.

The proposed system makes use of MATLAB 0.9 R2018a software for processing of the MRI images. The name MATLAB stands for Matrix Laboratory. It provides vast library of mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration and solving ordinary differential equations.

Initially, the MRI image need to be enhanced. For this purpose, Otsu's method is used which is clustering-based technique. The result of Otsu transformation is shown in fig. 3 and its histogram is shown in fig. 4

For the segmentation process, initially some morphological operations need to be performed on image. Opening is an erosion operation followed by dilation operation using predefined structuring element. Closing is a dilation operation followed by erosion using predefined structuring element. Opening and Closing operations are performed. The results are shown in Fig. 5 and Fig6.

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Fig. 2. Original image

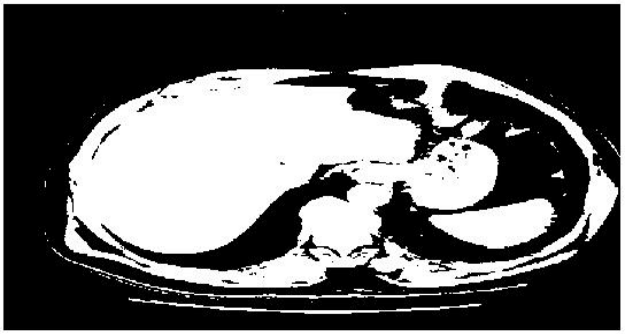

Fig. 3. Otsu's Transformation

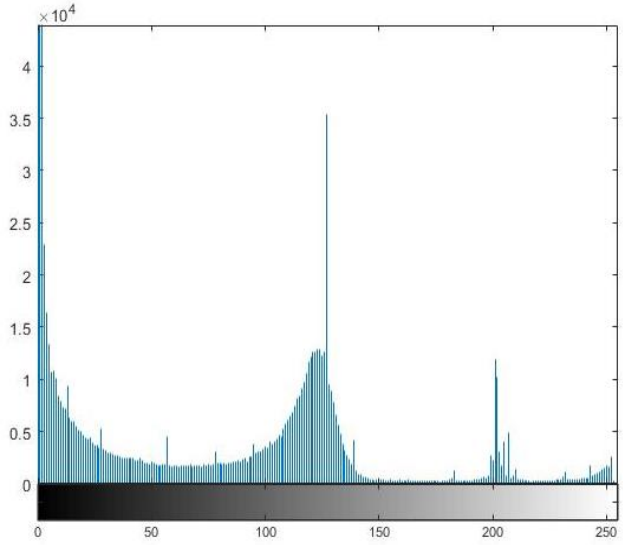

Fig. 4. Histogram of Otsu's Transformation

Fig. 5. Result of Opening Operation

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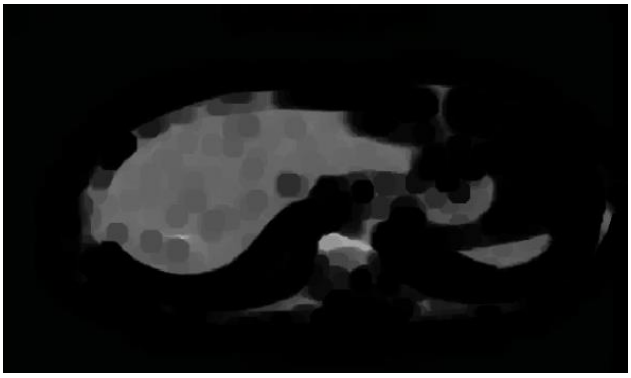

Fig. 6. Result of Closing Operation

VI. CONCLUSION

The proposed method deliberately consists of Otsu's preprocessing technique. Among all methods and techniques, image enhancement will be performed in the first attempt before proceeding towards image segmentation. The result of Otsu's enhancement is an assimilated contrasting image. Segmentation of the image will be performed with the method of watershed transformation. Different preprocessing technique such as image opening and image closing has been performed for a suitable and expedient outcome. Feature extraction plays an important role to highlight the cancer cells which will assist the doctors and radiologists to locate the exact position of cancer cell in Liver.

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