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Feature Extraction of Liver Cirrhosis by Using Image Processing Techniques

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Abstract: Early diagnosis of liver cirrhosis is important. There are several modalities on which we can perform image processing such as Ultrasound (USGs), Computed Tomography (CTs) and Medical Resonance Imaging (MRI). In this paper, we have used Computed Tomography scans for the early detection of the liver cirrhosis. We have used several pre processing techniques to make the images noise free and for better appearance. We have applied morphological operations to identify several features of the CT scans. Morphological operations process objects in the input image based on characteristics of its shape. Some of the morphological operations are dilation, erosion, opening, closing, thinning and thickening etc. Early diagnosis of liver cirrhosis is useful but further research is still needed.

Keyword: Image Processing, Morphological Features, CT scans, Cirrhosis.

I. INTRODUCTION

Liver cirrhosis is the end stage of the liver's chronic disease. In this, the healthy and normal tissues are replaced by scar tissues and prevent the liver from working properly. It happens over a long period of a time. The scar tissues make liver lumpy and hard, and after some time liver starts to fail. Liver cirrhosis results in multiple complications induced by portal hypertension and nodular regeneration. It is considered as irreversible process and only solutions is the liver transplantation. So, early detection of this is really important. Early detection of liver cirrhosis was shown to be improved by regression of collagen tissue [ref. 1]. Regression is normally associated with advancement in clinical status but can fluctuate with the degree of advancement. Prognosis and management of chronic liver disease is related to the amount and progression of liver fibrosis [ref 2].

There are several reasons which cause the liver cirrhosis some of them are too much consumption of liver for long period of time, hepatitis, non alcoholic steatohepatitis (NASH), blockage of bile ducts and budd-chairi syndrome etc.

We will be extracting morphological features from CT scans having liver cirrhosis. CT scans are the most sensitive diagnostic tool for evaluating morphological changes [ref 4]. Changes in the size and volume distribution are easily available in a CT scan. When liver cirrhosis progress is enforced experimentally, there is a high correlation with the fibrosis grade, though this has not been proven clinically [ref 5]. The limited spatial resolution of CT allow detection of only fibrous septum

II. RELATED WORK

Dr. Punal.M.Arabi, M.R Ramya, Sanjaya Pandey, Varini Chinnabhandar et al(2017)[16]: this paper used novel methods GLCM (Gray Level Co-occurrence Matrix) and Pixel Intensity Matrix after obtaining CT scan images (Computed Tomography) of healthy liver and cirrhosis affected liver. Performance Evaluation of both matrices is carried out to analyze cirrhosis liver. GLCM is a statistical method of examining texture that considers the spatial relationship of pixels in consideration. The GLCM functions indicate the texture of an image by calculated how often pairs of pixel with specific values and in a specified spatial relationship occur in an image. Later these functions create a GLCM, 73 then they extract statistical measures from this matrix. From every image acquired, region of interest is selected and GLCM parameters are found out using GLCM matrix.
Advantages: the GLCM parameters Contrast, Correlation and Homogeneity parameters of normal liver and Cirrhosis liver vary from each other whereas the energy values for both are nearly same. Contrast values of cirrhosis liver are higher than normal liver whereas Correlation and Homogeneity of normal liver holds a higher value than the cirrhosis affected liver. Also, the pixel intensity matrices of these images are obtained. The parameters namely Standard Deviation, Mean, Entropy and Variance are found for every image taken for experimentation. The results show that the mean and variance of normal liver is more than that of Cirrhosis liver whereas standard deviation and Entropy of normal liver and Cirrhosis liver lies in same range.

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Disadvantages: the energy values of normal liver and cirrhotic liver are nearly same because of which they had the problem in detection.

Francesco Agnello, Marco Dioguardi Burgio et al(2016)[17]: This paper describe the optimal MRI study protocol of the liver and the differences in stage of enhancement between cirrhotic and normal liver by using gadoxetic acid and also discuss the also illustrate the differences in phases of enhancement between gadoxetic acid and extracellular contrast agents and discuss how to obtain and recognize an adequate hepato-biliary phase

Advantages: Gadoxetic acid improves detection and characterization of focal liver lesions in cirrhotic patients and can estimate liver function in patients undergoing liver resection.

Disadvantages: The main disadvantage of liver magnetic resonance imaging (MRI) with gadoxetic acid is the contrast cost: the purchase price of gadoxetic acid is approximately twice that of gadobenatdimeglumine.

Mohamed E. M. Garelnabi, Mohammed A. Ali Omer et al(2016)[18]: In this review researchers, characterize and identify HCC using classification depending on the basis of disparity of grey level of plain, arterial and venous phases in CT images.

To characterize the hepatocellular carcinoma HCC CT intensity relative to normal liver tissue and other abdominal organs kidney, pancreas and stomach. The method used was the texture analysis which is depends on the collection of CT Number in Hounsfield Unit as excerpted from the k-means technique and the CT system used was tri-phases multidetector computerized tomography MDCT. The analyzed data showed that: the detected mean size of HCC lesions was 11.2±5.3 cm2.

Advantages: Multi-detector computerized tomography MDCT , which in turns leads to an increased enhancement (low density) of the tumor relative the surrounding liver parenchyma during the hepatic arterial phase

Disadvantages: Diagnosis of CT scans could not be sufficient for proper image interpretation even for experienced radiologists.

Yoon Jin Lee, MD Jeong Min Lee et al(2015)[19]: This paper shows that MRI has higher overall per-lesion sensitivity extent than CT and can be more effectible with the use of hepatobiliary-specific MR contrast agents, even in challenging situations such are end-stage liver disease and lesions smaller than 1 cm.

Advantages: MR imaging showed higher per-lesion sensitivity than multidetector CT and should be the preferred imaging modality for the diagnosis of HCCs in patients with chronic liver disease.

Disadvantages: the 95% CIs were not substantially wide, reseachers believe that these results are valuable. However, the heterogeneity in this type of diagnostic study still remains a point of concern.

Garima Sharma, PoojaSharma et al (2015) [20]: Gd-EOB-DTPA is a contrast agent developed for MRI. We use dynamic hepatocyte-specific contrast-enhanced MRI (DHCE-MRI) to evaluate liver volume and function in the liver cirrhosis, correlate the results with standard scoring models and explore the inhomogeneous distribution of liver function in cirrhotic livers

Advantages: The combination of DWI and PWI of the liver may supply additional tools to assess liver function, providing information concerning both the soft-tissue characteristics and the vascularity of the lesions. By diagnosing both MR perfusion can improve the sensitivity and specificity of diagnostic liver imaging.

Disadvantages: MRI identify specific features of cirrhosis such as hepatic vein narrowing, caudate to right lobe ratio ,and expanded gallbladder fossa, but remains lacking in earlier stages of fibrosis. Hence, assiduous efforts have been made to search for technological developments.

Elsayed Elmekkawy Elsayed, Enas Mohammed Koryem et al(2015)[21]: MDCT is currently considered one of the most reliable techniques for evaluating hepatic cancer in the presence of cirrhotic liver disease and it is primarily involved in patient treatment strategies

Advantages: Multidetector CT (MDCT) has reasonable sensitivity and high diagnostic accuracy in the detection of hepatocellular carcinoma in patients with cirrhosis who will undergo liver transplantation according to the Milan criteria.

Disadvantages: Patients who are at increased risk for developing HCC undergo routine imaging surveillance, and once a focal abnormality is detected, evaluation with multiphasic contrast material enhanced computed tomography or magnetic resonance imaging is necessary for diagnosis and staging.

Ozum Tunçyurek, M. Onur Turkkan et al(2014)[22]:In this paper evaluated fibrosis and cirrhosis in cases with non alcoholic fatty liver disease by means of transient elastography and revealed that data equivalent to biopsy could be collected, that could not reach this result with the method of strain elastography. the stages of hepatosteatosis could not be differentiated with the EL examination. Therefore, it was thought to be of no benefit to the selection.

Advantages: The elastography technique failed to clearly differentiate between the degrees of hepatosteato-sis, which could be differentiated by B-mode Ultrasound.

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Disadvantages: Difficulty in carrying out the technique in the patients with a high BMI .the evidence with this approach is still too limited to allow recommendation for its clinical use, according to the EFSUMB recommendations.

Karthik Kalyan,Binal Jakhia et al(2014)[23]: In this study, five feature classifiers have been investigated for diagnosing the liver diseases. The accuracy of the classifier was based upon the feature set that has been used, selected training samples and classifier's ability to learn from the training samples

Advantages: GLRLM and mixed feature set showed excellent accuracy in training as well as testing. The stages of hepatosteatosis could not be differentiated with the EL examination. Therefore, it was thought to be of no benefit to the selection.

Disadvantages: The ultrasound image of liver cirrhosis shows inhomogeneous echo texture and irregular nodular liver surface .Most gray levels of cirrhotic tissue appear darker than the normal tissue.

Kwang Baek Kim, Hyun Jun Park et al(2014)[24]: the fuzzy ART learning is applied to classify pixels into the same objects of their labels such that the appendicitis could be extracted based on its morphological features.

Advantages: The sensitivity of the appendicitis extraction is greatly improved from 67.5% (K-means based) and 82.5% (ART2 based) to 95% by this proposed method.

Disadvantages: Clustering errors cause false extraction of appendicitis. In order to overcome this huddle, we need other morphological attributes in consideration.

Devendra Joshi , Narendra D Londhe (2013) [**25**]: In this paper use adaptive thresholding technique for segmentation of liver tumor. Goal is to produce a technique in MATLAB for automatic segmentation by using DICOM images and it is processed and further converted in to jpeg images for segmentation.

Advantages: Segmentation method improves the segmentation performance compared with the conventional process based on a regular gray value.

Disadvantages: Liver imaging in patients with a history of known or suspected malignancy is important because the liver is a common site of metastatic spread, especially tumour from the colon, lung, pancreas and stomach, and in patients with chronic liver disease who are at risk for developing hepatocellular carcinoma.

III. METHODOLOGY

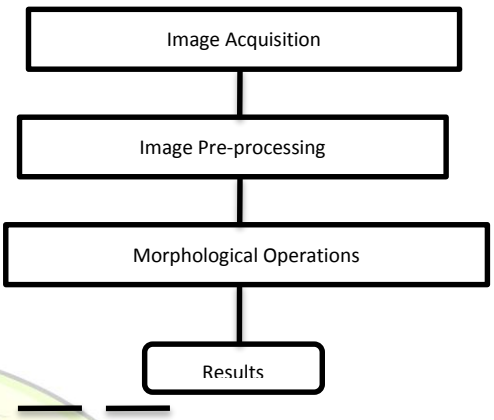

Fig. 1 Flowchart used

A. Image Acquisition:

This step is necessary for performing the image preprocessing on any other image processing techniques.

B.Image Preprocessing:

For getting better result this always performed before any image processing techniques.

I.Gaussian noise: it is a typical additive noise and independent at every pixels.

II.Wiener filter : it is used for image restoration which is a highly effective filter for removing Gaussian noise in images and optimize the mean square error by removing the additive noise and inverts the blurring simultaneously

C.Morphological operations:

Influence the shape and form of object which applied on binary images and produced the output of same size of images .there are so many morphological operations here we discussed some features .These operations are nonlinear in nature

I.Dilation: it is the fundamental step of morphological operations .It basically uses the structuring element for spreading the shapes of input images. It is the translation invariant which is equal to Minkowski addition. The value of the output pixel is the *maximum* value of all the pixels in the input pixel's neighborhood. In a binary image, if any of the pixels is set to the value 1, the output pixel is set to 1.

Notation of dilation $=A \oplus B$

II.Opening: this shows the effect of removing the small and thin object and breaking the object at thin points ,contour the object and smoothing the images. Opening operation is an erosion followed by a dilation: Stray foreground structures that are smaller than the

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structure element will disappear. Larger structures will remain.

Notation of opening :$A_oB=A\Theta B \oplus B$

III.Closing : it is the process of dilation followed by erosion .It has the effects of filling thin holes, smoothing the object and connecting near by objects. Closing can sometimes be used to selectively fill in particular background regions of an image. Whether or not this can be done depends upon whether a suitable structuring element can be found that fits well inside regions that are to be preserved, but doesn't fit inside regions that are to be removed.

Notation of closing $A\bullet B=A\oplus B\Theta B$

IV.Thinning: it is the morphological operation used for removing selected foreground pixel from the binary images somewhat like the erosion or opening, particularly uses for skeletonization. In this mode it is basically used to tidy up the output of edge detectors by reducing all lines to single pixel thickness. Thinning is normally only applied to binary images, and produces another binary image as output.

V.Thickening: Thickening is a morphological operation that is used to *grow* selected regions of foreground pixels in binary images, somewhat like dilation or closing. It has several applications, including determining the approximate *convex hull* of a shape, and determining the *skeleton by zone of influence*. Thickening is normally only applied to binary images, and it produces another binary image as output.

IV. Results And Discussion

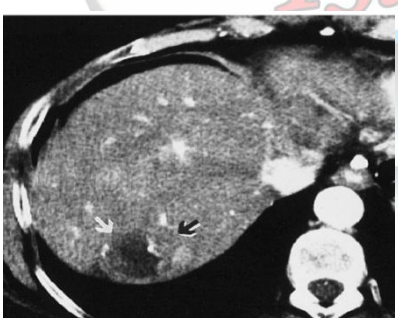

Fig 2: Original Image

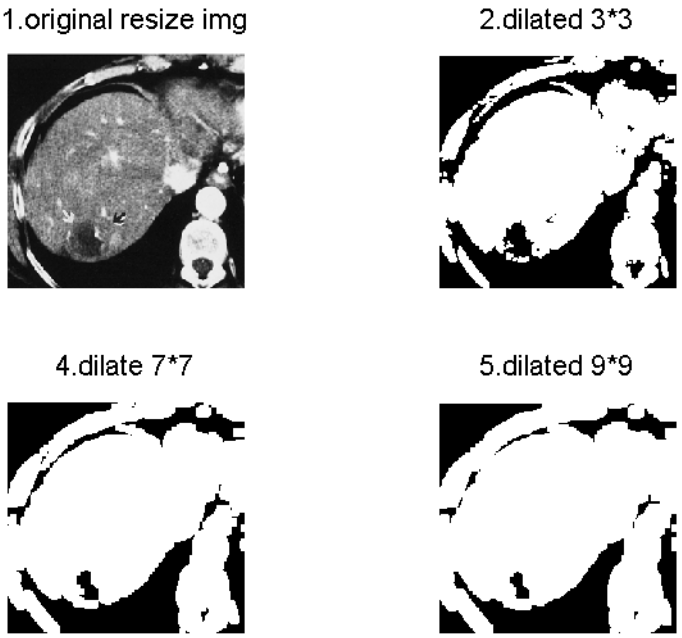

Fig. 3: Dilation of Image

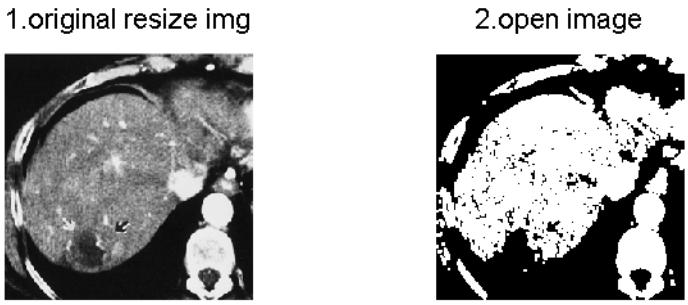

Fig. 4: Opening of Image

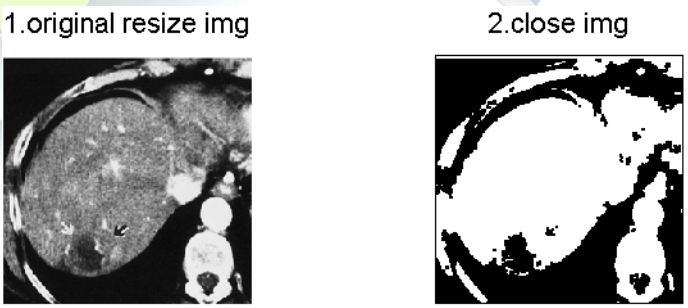

Fig5:Closing of Image

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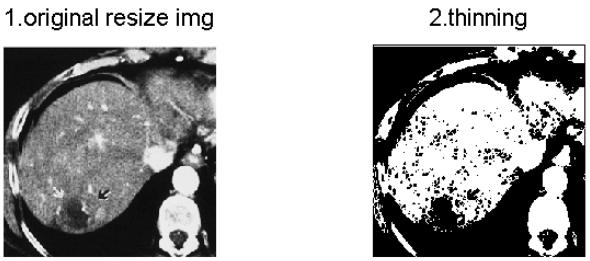

Fig. 6: Thinning of Image

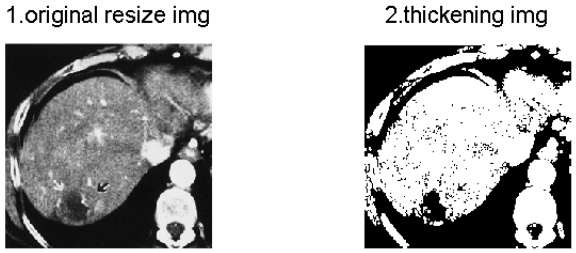

Fig. 7: Thickening of Image

V. CONCLUSION

In this paper we have applied feature extraction techniques on CT scan images after applying the pre-processing techniques. It produced the better result in reconstruction of structure of images so the diagnosis of liver cirrhosis can be enhanced and get better resolution. By applying this image processing techniques we got the improved quality of images.

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