

Automatic Liver Lesion Extraction using Roberts Cross Edge Detection

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Abstract— Liver cancer is one of the severe diseases that leading causes death. Extracting liver lesion is a bit challenging task in the field of image processing. It can be extracted from CT scan images by analyzing the liver shape at all possible extents. Primary liver cancer may originate itself as Hepatocellular Carcinoma. This paper proposed an automatic liver lesion extraction using Roberts Cross Edge Detection for better recognition rate. The Roberts processed with 2x2 matrixes with gradient magnitude that resulted sharp edge detection that can be dilated later for missing edge filling. System pertain various preprocessing techniques for enhancing the liver image that helps to extract liver lesion with high precision rate. This system indeed contributes in the field of medical science for detecting liver cancer automatically without any human intervention.

Keywords— Liver Lesion, Hepatocellular Carcinoma, Liver Cancer, Dilation, Roberts Cross Edge Detection, CT Scan, Gradient Magnitude.

I. INTRODUCTION

Liver is one of the biggest inner organs of the human body which is placed in the top right section of the belly. It occurs under the diaphragm and above the abdomen, right kidney and intestines. Liver has two major sectors like left lobes and right lobes. Liver and its functional agents work simultaneously to process, absorb and digest food. The main duty of this organ is to refine blood and also detoxes metabolize drugs and chemicals. Liver is also helpful for producing protein like albumin which is necessary for blood clotting. Liver cancer is most dangerous types of cancer which claims more life each year, it occur by taking alcohol, birth defects, incurable infection with diseases like hepatitis B and hepatitis C, hemochromatosis and cirrhosis. CT scan is an important technique of medical imaging for tomography which is used for scanning liver cancer image. In clinical diagnosis system; prevention and medication of liver cancer is one of the vital focus area of research in medical science. Detection of cancerous tissue is actually a crucial task due to its structural difference in liver with sex, body shape, age and low contrast between cancerous and benign tissue.



Fig. 1. Healthy Liver CT Scan Image



Fig. 2. Cancer Affected Liver

Fig 1 represents normal liver or healthy one and fig 2 represents the cancerous liver with impariments.

II. RELATED WORKS

Atrayee D. et al. [1] derived a method for detecting the liver cancer and suggested the solutions for the same. Author tried to recognize the cancer using watershed method and Ostu method is also used to enhance the MRI imaging. In order to achieve high accuracy, B.Lakshmi Priya et al. [2] devised a segmentation technique that was linked with contrast vision driven elastic optimization. Curvature optimization has used a bottom-up global set contrast technique for detection. Mean shift has been used to assess the saliency map with weighted coefficient technique, which increases the saliency detection's precision. When compared to the currently used segmentation technique, the proposed segmentation technique produces accurate results. F. P. Romero et al. [3] derived a method using deep learning to classify the impaired cells from CT scan images of liver. As per the cancer cells or spot; it has been identified that there is no particular shade for the cancer cells or spots so that is why it is challenging for model to predict the cancer correctly with high precision. A system's sample size will be limited if it has been taught to recognise specific patterns, and the false error rate could increase as a result of insufficient data samples. It is preferable to forecast cancer utilising a morphological and filtration technology that can precisely separate or segment the malignant region from the liver. Here, the system had a 96% accuracy rate and suggested.

III. PROPOSED WORK

Here the proposed work is efficient to deal with the cancerous cells to get identified whether it is benign or malignant by using Robert Cross edge detection technique which is able to detect the affected regions or impaired cells and predict the disease accordingly. There are various preprocessing techniques are involved in it to get enhances the CT image for better output such as morphological dilation, histogram equalization, thresholding, segmentation and many more.

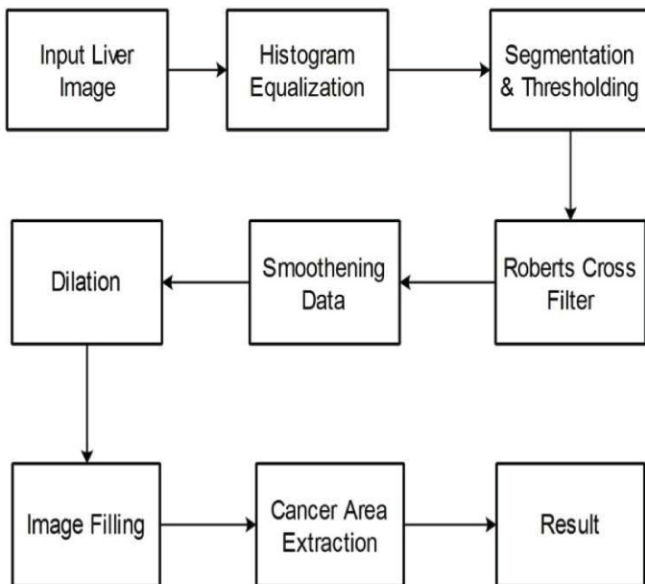


Fig. 3. Block Diagram of Proposed System

A. Histogram Equalization

In digital image processing; histogram equalization plays a very vital role for converting RGB image into gray scale image and also amend contrast according to the requirement that resulted better outcomes as compare to the input one. It is also able to classify image background and foreground that require to be masked by segmentation.

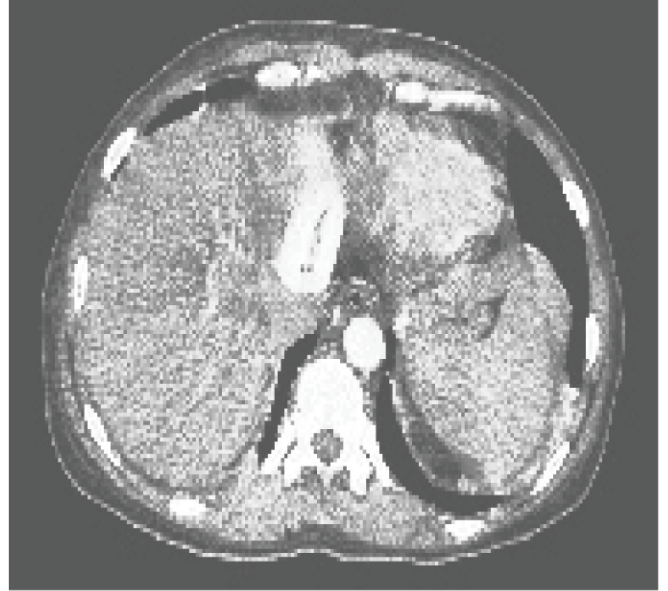


Fig. 4. Histogram Equalization

B. Segmentation by using Thresholding

Thresholding is an effective approach for segmentation that is essentially used for converting grayscale image into binary image by electing a convenient threshold value T . In case; the pixel intensity is less than the value of threshold then it will be declared as black color pixel model otherwise it is white, where 1 represents white and 0 as black. Here the major purpose of applying this technique is to extract field of interest by masking nerves and background of image.

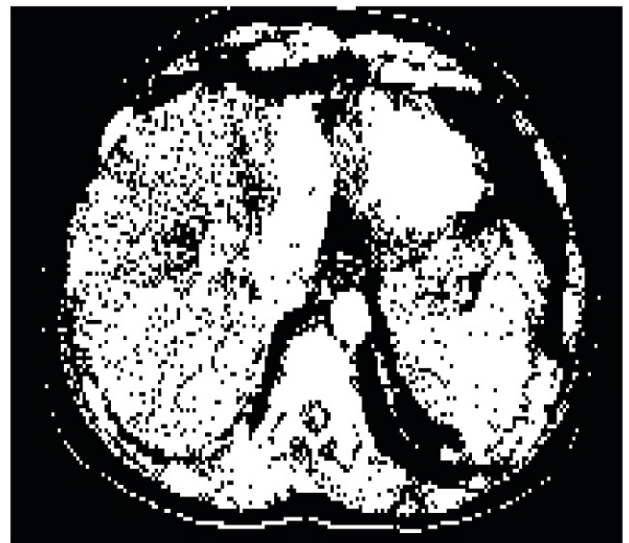


Fig. 5. Segmentation by Thresholding

C. Robert Cross Edge Detection

In digital image processing; Roberts Cross operator is an effective and prominent algorithm for edge detection. This operator acts as a 2D spatial gradient measurement over an image, thus it highlights the arena of high spatial frequency. The Roberts Cross operator conforms the combination of 2x2 convolution kernels as G_x and G_y . Thus to determine the gradient vector; Roberts Cross operator traverse the image matrix diagonally that would be more superior to the other types of horizontal and vertical edge extraction. Let input matrix A -

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & & \\ a_{21} & a_{22} & \dots & & \\ \dots & \dots & \dots & & \\ & & & & \\ & & & & \end{bmatrix}$$

A is considered as input image which is in the form of array and G_x and G_y are considered as the kernel mask or the gradient kernel of the matrix which is to be multiplied with given array, G_x is considered as the horizontal kernel of the matrix and similarly G_y is considered as the vertical kernel of the matrix that decide the flow of the matrix computations.

$$G_x = \begin{bmatrix} +1 & 0 \\ 0 & -1 \end{bmatrix} * A, \quad G_y = \begin{bmatrix} 0 & +1 \\ -1 & 0 \end{bmatrix} * A$$



Fig. 6. Robert Cross Edge Detection

D. Morphological Operation

The purpose of the morphological operation is extracting ROI and also helpful for defining image structure. There are mostly two variety of morphological operation i.e. Erosion and Dilation. In this work, only dilation has been used because it fills microscopic holes by rendering pixels to the

perimeter of an object in an image and finally transformed the object more observable as compare to the previous.



Fig. 7. Filling Regions and Holes

E. Cancer Area Extraction

If liver image may have consecutive black pixel values; it means that cancerous spot is available in the output image otherwise no cancer area will be detected.



Fig. 8. Cancer Area Extraction

F. Flow Chart

Here the flowchart expresses the flow of the diagnosis operation. At first CT scan data in the form of image has been inputted for enhancement and contract enhancement has been performed here by the help of histogram equalization, it also visualize the arteries or veins that are considered as the noise of the image which is required to remove in upcoming steps. Then Segmentation is to be performed by thresholding for segmenting the region of interest. Then edge detection method has to be applied i.e. Robert Cross for extracting the horizontal and vertical edges

that helps to predict the disease as per the size of the cancerous cells. It also uses the smoothening method for highlighting the spots of impaired cells and remove the noisy regions. If the impaired region and its entropy met the threshold based value then the area has been predicted as lesion one or cancerous else no cancer area has been detected.

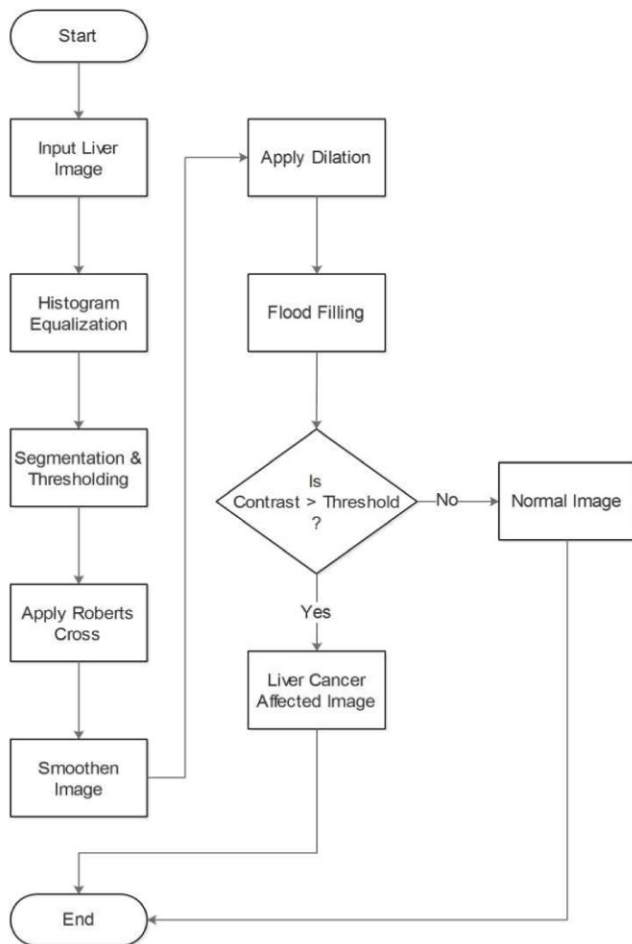


Fig. 9. Flow Chart

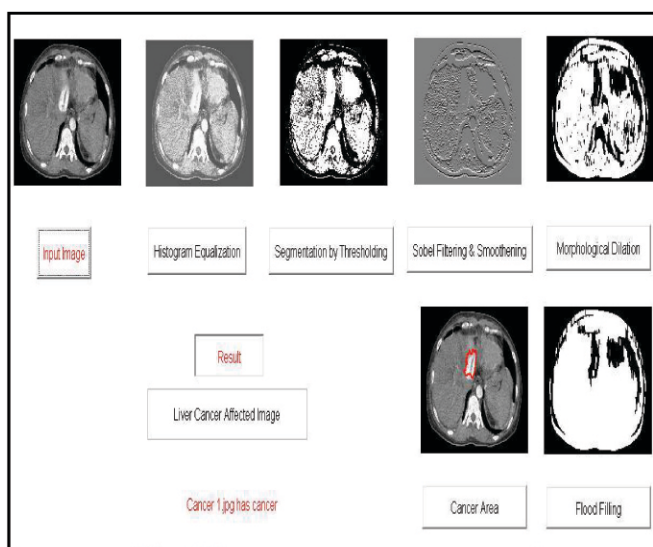


Fig. 10. Graphical User Interface

IV. RESULT ANALYSIS

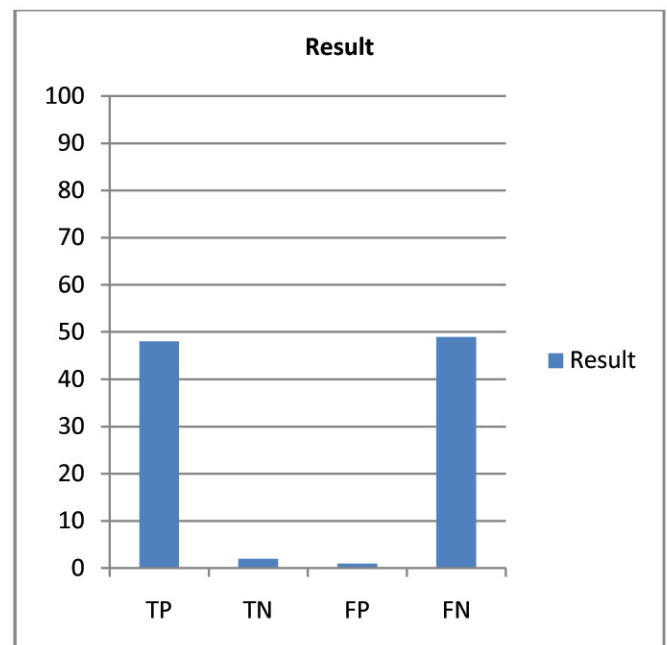
The result has been obtained from false negative, true negative, false positive and true positive. The total testing dataset contains 100 images, where 48 as true positive that means 48 images predicted as cancerous. Likewise, 49 images predicted as false negative that means no cancer spot is exist. Two images from dataset are predicted as true negative that means cancer exists but it has not been recognized. Single image is predicted as false positive that means cancer spot not exists but it has been recognized. Thus according to this data, final accuracy has been evaluated as 97%.

Table 1 Result Analysis

Terms	Proposed
Total Number of Image that dataset exits (TC)	100
True Positive (TP)	48
False positive (FP)	49
True Negative (TN)	2
False Negative (FN)	1

$$\text{Accuracy} = \frac{TC - (TN + FP)}{TC} \times 100\%$$

Graph 1 Result



V. CONCLUSION & FUTURE SCOPE

In this study, we proposed a system which is very much adequate for identifying liver cancer from CT scan image. The experimental outcome shows that the technique which is enough able to segment the cancer with high level of accuracy. Roberts is an effective approach for detecting liver cancerous spot with high precision and recall. System acquired 97 % of accuracy with high false rejection and true acceptance rate. This system can acquire bit more accuracy in future and can be implemented over automatic diagnosis

the cancerous part through CT Scan or MRI machines. It may impact boom in the field of medical science.

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