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Liver Tumor Segmentation using Adaptive Thresholding

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Abstract: Liver the largest organ in human body plays an important role in detoxification of various metabolites, protein synthesis, and the production of biochemicals necessary for digestion. But liver cancer is one of the important disease which affect the liver. The different imaging modalities such as ultrasound scan, CT scan, MRI scan etc are used to obtain the abdominal images & here we concentrate on CT images. The manual process of doing segmentation from CT image is very time consuming and tedious task requiring expert radiologist and hence it is associated with many challenges. Therefore, we need automatic machine learning process, helps to achieve automatic segmentation of liver tumor. Here we use adaptive thresholdig method to sement the liver and liver tumor from abdominal CT image.

Keywords: Liver, Tumor, Abdominal CT scan, Segmentation.

I. INTRODUCTION

Tumors are abnormal growth of tissues and they are of two types malignant and benign tumor. Malignant tumor are cancerous and mortality rate is very high.but benign tumor are non-cancerous. Due to this so many peoples are died. Therefore the detection of disease at it's early stage will be much helpful. Different imaging modalities such as US, CT, MRI scan are used for the detection of diseases. CT images are commonly used. Because it produce high quality images in real time and cost is comparatively less than MRI scan. Segmentation of liver from abdominal CT scan is the critical step, because the intensity values of liver tissues and adjacent tissues have same value.Here we do adaptive thresholding method to extract the liver from abdominal image and same method is used to segment the tumor from the liver.This is used for the diagonosis.

II. LITERATURE REVIEW

Several research is going on segmentation of tumors. The relevance of these works are tumors are most common among the world. In this work abdominal CT image is used for the extraction of liver. The abdominal image contain several organs and intensity values of tissues are almost same. So it difficult to extract liver and it's tumor. Manual process of doing segmentation is very difficult ,hence machine learning process make it more easier.This will provide accurate diagonosis.

Various techniques used for segmentation are thresholding, region growing, histogram based segmentation. In [1] describes that segmentation is based on the anatomical structural details. The main difficulties are constant gray level based segmentation doesnot produce the required regions. Ref [2] describes about the various morphological operations. 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.
Edge based technique is based on the sudden change in the intensity value, the pixel intensity values of different organs in abdominal image is almost same, and thus this method fails. Clustering technique is based on the collection of similar pixels in a cluster, this also doesnot provide accurate results. This technique provide good results when two or more such methods are combined.

In [4] proposed watershed and gradient vector flow to the detection of brain tumor. One of the main disadvantage 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. [5] designed a segmentation technique based on K means and level set method. FCM clustering technique [6] is used to detect the brain tumor.

Several methods are available for segmentation, but these technique doesn't give any accurate results. The above methods are very complex , this highlight the necessity of better technique for liver tumor segmentation. In this work adaptive thresholding is used to segment the liver and tumor.

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III.METHODOLOGY

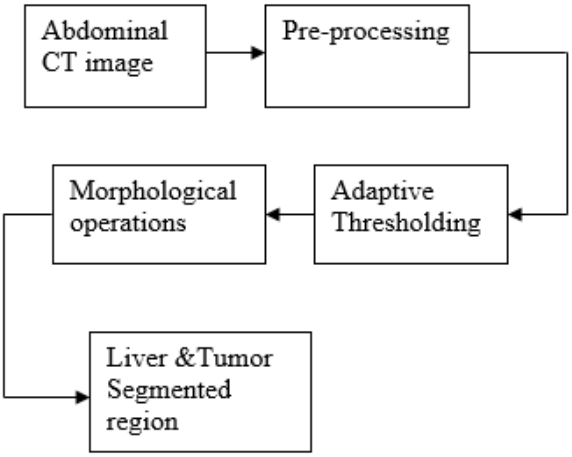

Fig. 1. Block diagram of liver segmentation

A. Abdominal CT image

Abdominal CT image consist of liver and other organs. Segmentation of liver from abdominal region is based on their intensity value.

B. Pre-processing

The main function of pre-processing is to suppress the noise present in the image and to enhance quality of the image.In biomedical image processing the main difficulties are the structure is complex, unknown boundary between the organs, shape, structure are vary from patient to patient even if same imaging modalities are used.

C. Adaptive thresholding

Segmentation means partition an image from it's background . Thresholding is the simplest segmentation technique, here only one intensity value is taken as the threshold value, thus only two classes are generated, but it is not suitable for biomedical images, because the intensity values of organs are not vary much. Hence, adaptive thresholding is used. Here different threshold value is choosen for different areas.It is based on the difference in pixel intensities of each region.

Probability that the pixel belongs to Region of interest(ROI) has intensity value 'h'

$$P_0(h)=P\{f(c)=h|c€Io\}$$

Where c is an integer representing the location of the pixel, I_0 is the image and h(c) is the function of c.

Probability that the pixel belongs to background has intensity value'h'

$$P_0'(h)=P\{f(c)\ h|c€I_0'\}$$

Thus the probability for any random pixel can be considered as P(h)

$$P(h)=\alpha P_0(h)+(1-\alpha)P_0'(h)$$

(1-α) is the probability that pixel belongs to background,α is the probability that pixel belongs to ROI.

The threshold value for segmentation can be suitably selected using Shannon's entropy function E(h)

$$E(h)= \alpha\frac{P0(h)}{P(h)}\log\left(\alpha\frac{P0(h)}{P(h)}\right)-((1-\alpha))\frac{P0'(h)}{P(h)}\log((1-\alpha))\frac{P0'(h)}{P(h)}$$

Threshold value is initially selected from the peak value of histogram. This act as a seed point, this value is varied based on Shannon's entropy function E(h)The minimum value for shanon's entropy function is selected as new threshold.

D. Morphology

Morphology is based on the set theory. It doesnot alter the shape of an image. The different morphological operations, dilation helps to fill the holes & smoothens the contour lines, erosion removes the unwanted objects.

IV. RESULTS

The images or datasets are collected from Travancore scan centre. 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 4.

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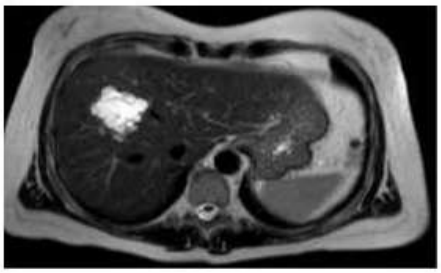

Fig. 2 Original image

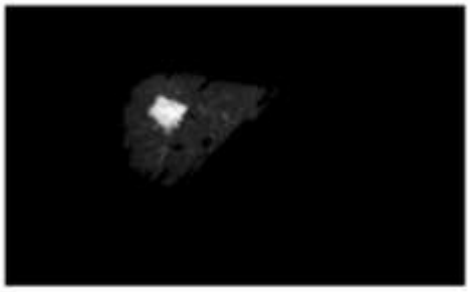

Fig. 3 Segmentation of liver from the abdominal image

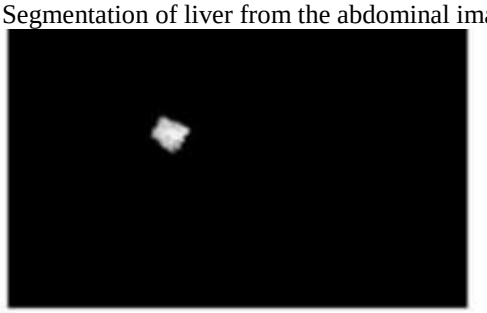

Fig.4 Segmentation of tumor from the abnormal liver region

V. CONCLUSION

Segmentation of liver is a challenging task due to the similar intensity values between the tissues. Here liver and tumor segmentation is based on CT images. 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. The results shows that our method performs well in segmentation.

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