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A Review on Techniques for Features Extraction for Liver Segmentation

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Abstract
Image segmentation is the process of dividing the image into subparts to abstract the meaningful information. It divides the image into subparts on the basis of pixels, i.e strongly correlated pixels are grouped together. Segmentation is performed by extracting various features. These features are classified in different groups like pixel-level features, local features and global features. Local features determine the edges, boundaries, corners; regions etc. Whereas global features include texture, shape, and colour. In medical imaging liver segmentation is one of the most challenging tasks due to its low-contrast nature with neighbouring organs. This paper will help the researcher to start their work in the field of liver segmentation using features extraction.

Keywords: CT, Morphological, Structural.

1. Introducton

Medical imaging refers to the technique of looking inside a human body using non-invasive methods. This means that doctors need not to open the entire body of patient for surgical medical practices. Medical imaging is used for diagnosis and for treatment purposes under different medical conditions. In medical imaging we make use of imaging techniques that use radiations that further forms electromagnetic spectrum. To find out the abnormalities in the liver or any interior organ of the body we take images like CT scans or MRI for brain tumour detection. This is done to diagnose the actual problem.Segmentation is performed on the basis of different features and is called feature extraction. Feature extraction is the process of gathering visual information from given image for the purpose of making record and to perform some actions on the data or information retrieved. The information or feature extracted can be used to describe the contents of image to be segmented. The idea of detection and extraction of features is to describe the behaviour and action of problem. Visual features can be low-level or high level for example: shape, intensity, texture, and colour.

Features being extracted are used for matching (healthy liver with infected liver), pattern recognization (pattern of the change in the shape of liver) and is used in selection and classification. The image we input have large amount of unnecessary and redundant data so the selection is made to reduce the features and this process is called feature selection and that data is provided to classification and those features that are differentiated are used in classification task for segmentation. Segmentation is the part of image analysis and extraction and is most challenging task now a days.

Feature extraction should be carried out by keeping some of these factors in concern :- (1) the features extracted from a given image should provide enough information carried in an image. (2) Computing of an image features should be easy. (3) And it should provide us with the suitability of the data or information gathered from image so that it can easily help in segmentation.

There are three general features colour features, texture feature, statistical features:

1. Colour feature : It is the most helpful feature that provide us a lot of information and colour histogram helps us in its representation.It is robust, computational simplicity (complexity O(x,y) for the image size (x,y)), low storage Requirement(Histogram size is small than the given image)

2. Texture feature: It provide information about texture like smooth, vertical or horizontal generally with the help of texture feature it's easy to find out pattern in a given image that helps out in finding the disorders, disease in human body and even help in tumour detection. Statistical measures of texture feature include entropy, homogeneity, contrast, wavelets, and fractals.
   a. **Entropy:** It is the average of the maximas of the image intensity.
   b. **Homogeneity** :Finding the similarity between different elements distributed in gray level matrix by using local spatial feature given by equation:

$$\sum\_(i,j)\text{P (i, j) /1+| i-j |}$$

   c. **Dissimilarity**: It is the comparison taken between different segmentation results. Feature vector is considered in texture feature to find dissimilarity between two factors:

fg = (fg,t : t= 1,…..,T) and fq= (fq,t : t= 1,…..,T)

Then, D (g, q) is represented as equation:

$$\text{D (g, q)} = \sum_{t=1}^{T} f\text{q, t log}_{fq,t} fq, t$$

3. Statistical feature using intensity observation: Intensity information is required to standardise the colour information in some format as it makes easy to find the liver status and for detecting tumour for this colour space are used like RGB (red, green, and blue). Intensity component is given by equation :

$$\text{I=1/3(R+G+B)}$$

   a. Mean intensities : Region of interest(ROI) is called mean intensity denoted by μ :

$$\mu = 1/\text{N}\int_{x,y} \text{ ROI(x, y)}dx\,dy$$

Intensity features extraction can be done either from coloured or gray-level histogram. For images with background, the gray values of each pixel are transformed to its optical density (OD).

OD=log10 (gray value of background)/ (gray value of the pixel)

Intensity based features are defined by sum and mean of OD of each pixel.

The process of extraction is carried out in number of steps first an image is considered to extract information, then local features (like (1) Edges: it's a pixel pattern in which the intensity widely changes (2) corners: are the points at which edges get intercepted (3) Region : closed boundaries with highly similar intensity value) are considered and then we move towards the global features that are calculated from entire image like its aspect ratios, moment invariants and intensity levels (high-low) are labelled, we get information about some areas of image that help out in the segmentation.

2. Literature Survey

Shenhai zheng, et.al (2017) Medical imaging plays an important role in medical research, the presence of noise and low contrast make automatic liver segmentation a challenge. Novel varitional semi-automatic liver segmentation is used to find the sign distance function (SDF) that represents the shape statistical model. To guide the PCA-based topological transformations global Gaussian and enforced local feature energy are established.CV model is used to achieve the closed contour of liver from complex background. Experiment is performed on two datasets so that shape prior and intensity information can lead to robust results

Yao Zhang, et.al (2017) Automatic liver segmentation is the most challenging task of liver segmentation due to the number of neighbouring organs and low contrast of liver.Cascaded structure has been purposed for automatic liver segmentation using CT scan. Fully conventional neural network (FCN) is trained for segmentation of liver then comparative study is made for performance evaluation of different segmentation models such as graph cut method, level set based method etc. As a post-processing step comparative study of different model is done, enhancement of FCN. This method is validated the dataset 3DIRCADb, and the results gives 92% of accuracy.

Kentaro Saito, et.al (2017) Multi-phase CT image is a technology for computer aided diagnosis images are provided different intensity features by contrast medium of multi-phase images that helps to detect tumour. This is the most difficult task to segment regions of liver from multi-phase images.Here anatomy feature based method is purposed which uses level set method for segmentation. Accuracy of this method fully depends upon initial contours, so initial features of liver are processed by anatomic features. Then ribs information is required to check and improve the accuracy of the segmented region. This was performed on 5 multi-phase images and the result shows that this purposed method has good accuracy for each and every phase.

Guodong Li, et.al (2016) Liver segmentation is the most difficult task in medical image processing field as there are number of neighbouring organs that leads to blur boundaries and low contrast CT images between liver and neighbouring organs to cope up with this problem, shape priors are required by using statistical shape model. Novel approach has been used for the automatic liver segmentation that is very effective in shape initialization and deformable graph cut method. This method was performed on 50 CT scan images and the method provided with accurate results of 92% for progressive detection of the liver surface.

Vimtha.G.Sekhar, et.al (2016) Disease diagnosis is done with the help of different medical image processing techniques used these days like CT/PET medical images. The technique of CT/PET for tumour segmentation present in the liver. Median filter and binary tree quantization algorithm are used to perform pre-processing and

segmentation. In the process of segmentation the pre-processed input images are provide to the binary tree quantization algorithm that represent the liver with the tumour in the form of cluster. According to this paper binary tree quantization method provided us with better results than the conventional K-mean algorithm. The researcher has put up a dataset of 10 images with 60 slices each which ends up with the result rate of 90%.

T.Kitrungrotsakul1, et.al (2015) Segmentation of the liver in computer aided diagnosis (CAD) system for liver diseases is one of the most difficult tasks. Here the slice by slice liver segmentation method is used in which the segmentation is done over the sliced images that leads to less memory usage by using super pixels and limited shape calculations which further speeds up the entire shape constrain calculation process. The effectiveness of this method has been proved by conducting experiments on 10CT volumes that leads to the result by average dice coefficient: 0.94, about 659.22 second in computation, and take only 1.5GB in memory usage.

T.M.Hassan, et.al (2015) CAD is a technology that is important for the doctors to decrease observational oversight and to understand medical images also by decreasing false negative rates. Detection /diagnosis of various diseases have been improved by using CAD system. Classification framework is purposed for CAD system to diagnose three classes of focal liver disease that are Cyst, Hemangioma (HEM), and Hepatocellular using ultrasound(US) image In this, pre-processing is done using median filter to enhance and remove the noise from ultrasound images followed by segmentation of liver region done by level set method.Algorithm used is fuzzy c-mean and multi-support vector machine (multi-SVM) is used to diagnose classes of focal liver disease.Researcher has used 10-fold cross validation methods and obtained classification accuracy of 96.5%

Ina Singh, (2015) In medical imaging, liver segmentation is very difficult task for detecting diseases and transplantation planning.This is due to the difficulty in predicting which patient will manifest clearly the symptoms variability present in liver like liver shape, size, volume or other diseases. Segmentation of the liver helps to know if liver disease is focal or diffused.

Being the most important organ of the body with vital functions such as protein synthesis and detoxification it is important to know the best segmentation technique for liver segmentation.

Here number of techniques like Region growing**,** K-Means Clustering, Level Set Method, Adaptive Thresholding, OTSU Thresholding, Region Splitting and Merging are discussed.

K-Mean algorithm is limited to only initial number of k-clusters if cluster selected is wrong it leads to number of results. Therefore it is suggested to have new K-Mean algorithm with new ant colony optimization that has ability to address initial k-clusters problem by selecting optimized clusters

3. Comparative Analysis

Author Name	Paper Name	Technique	Constraints
Shenhai zheng	A Novel Variation Method For Liver Segmentation Based On Statistical Shape Model Prior And Enforced Local Statistical Feature	PCA-based topological transformations global Gaussian and enforced local feature energy are established	shape prior and intensity information can lead to robust results
Yao Zhang	Fully convolutional neural network with post-processing methods for automatic liver segmentation from CT	performance evaluation of different segmentation models such as graph cut method	post-processing step comparative study of different model is done, enhancement of FCN
Kentaro Saito	Atomatic liver segmentation from multiphase CT image by using level set method	ribs information is required to check and improve the accuracy of the segmented region	work can be further enhanced by using structural properties.
Guodong Li	Automatic Liver Segmentation based on Shape Constraints and Deformable Graph Cut in CT Images	shape initialization and deformable graph cut method	shape priors are required by using statistical shape model

Conclusion

[Shenhai Zheng][1] Researched the methodology for liver segmentation based on structural and statistical shape features. These structural and statistical features are to be different for different types of segment of CT image. But the process of extraction sometimes will be time consuming if shape is deformed. Some shape related prior information will help in extraction of image segment with less time consumption.

This work can be made more efficient by including shape prior information of the liver into the CT image before segmenting liver from CT image. Later on performance can be compared on the basis of various performance parameters like SSIM, and time for extraction or segmentation

Future Work

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