An Efficient Automatic Liver Tumor Detection from Ct Images

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Abstract: *Liver cancers are one of the most popular cancers occurring now a day. The larger parts of liver carcinomas are because of liquor related cirrhosis and hepatitis. Early detection and diagnosis of liver tumor is important for the prevention of liver tumor. Since the tumor tissues and normal liver tissues have almost same intensity, it is a very difficult and challenging task to detect the liver tumor. For the accurate detection, efficient segmentation and classification methods are essential. Several techniques have been developed for the segmentation of liver tumor. Manual detection of liver tumor requires human interaction and is time consuming. As a result, automation of the tumor detection, segmentation and classification process is essential.*

Keywords*: SVM, GLCM,CT*

INTRODUCTION

Cancer is one of the common diseases nowadays. According to the statistics the estimated number of people living with cancer in India is about 2 to 5 million. Among the types of cancers, liver cancers are on a hike due to increased alcohol consumption. Also Liver is primary organ that get affected by secondary cancer. The liver tumor can be identified in a CT scan by a difference in pixel intensity from other regions of the liver. Manual detection of liver tumor requires human interaction and is time consuming. Also it depends on the ability of the observer to locate the location, shape and size of the tumor. So, automation of liver tumor detection is essential.Anisha[1] proposed that the liver cancer can be diagnosed in 3 ways namely Blood test, Imaging test and Biopsy. Automatic segmentation is a very challenging task due to several factors like, liver stretch over 150 slices in a CT image, intensity contrast between lesions and other nearby liver tissues is almost same and indefinite shape of the lesions. S. G. Armato[2] proposed that need a comprehensive set of clinical images to evaluate specific applications
There are several stages for liver tumor detection. Different stages for a liver tumor detection are:

PREPROCESSING

Image pre-processing can significantly increase the reliability of an optical inspection. Noise removal is also done here. Median filtering is used in the preprocessing stage.

The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "window", which slides, entry by entry, over the entire signal. For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D or higher- dimensional signals such as images, more complex window patterns are possible such as "box" or "cross" patterns. Note that if the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically. For an even number of entries, there is more than one possible median, see median for more details. Image normalization is used to minimize intra-image vari- ability in fundus images. Atul Kumar et al [3] proposed that color normalization can be utilized for brightness correction, color modification and contrast enhancement.

SEGEMENTATION

Image segmentation is the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Jayanthi[2] proposed Region Growing method for segmenting Liver portion.

The first step in region growing is to select a set of seed points. Seed point selection is based on some user criterion for example, pixels in a certain gray scale range, pixels evenly spaced on a grid, etc. The initial region begins as the exact location of these seeds.

The regions are then grown from these seed points to adjacent points depending on a region embership criterion. The criterion could be, for example, pixel intensity, gray scale texture, or color.

Since the regions are grown on the basis of the criterion, the image information itself is important. For example, if the criterion were a pixel intensity threshold value, knowledge of the histogram of the image would be of use, as one could use it to determine a suitable threshold value for the region membership criterion.

The segmentation result is refined by erosion to get the liver region precisely. Erosion is one of the two basic operators in the area of mathematical morphology, the other being dilation. It is typically applied to binary images, but there are versions that work on gray scale images. The basic effect of the operator on a binary image is to erode away the boundaries of regions of foreground pixels i.e. white pixels, typically. Thus areas of foreground pixels shrink in size, and holes with in those areas become larger. The erosion operator takes two pieces of data as inputs. The first is the image which is to be eroded. The second is a (usually small) set of coordinate points known as a structuring element (also known as a kernel). It is this structuring element that determines the precise effect of the erosion on the input image. Several other approaches to segment the liver should be mentioned. A model-based segmentation was also employed in a supervised segmentation using graph representation in [7]. Kumar S. S., Moni R. S., Rajeesh J. [6] segment the tumor portion in liver using Alternative FCM technique.

FEATURE EXTRACTION

When the input data to an algorithm is too large to be processed and it is suspected to be redundant then it can be transformed into a reduced set of features also named a feature vector. This process is called feature extraction. Shajahan[5] proposed GLCM for feature extraction. GLCM is one of the such statistical method and is used here.

Statistical method is the simplest approach which analyzes the spatial distribution of image gray levels by determining the local features of each image pixel and derives a set of statistics from their distribution. The statistical method can be categorized into different classes based on the number of pixels defining the local features, i.e., first-order, second-order and higher- orders. The first-order method evaluates the properties of the individual pixels and ignores their spatial interaction. The second and higher-order methods estimate the pixel properties occurring at different locations relative to each other. Histogram belongs to the first order approach while GLCM follows the second order statistics.

Gray Level Co-occurrence Matrix GLCM is the method of computing the frequency of pixel pairs having the same grey level in the image. The relationship between the reference pixel and the neighboring pixels is calculated to determine the textural features of the image. GLCM is calculated in four different orientations. Akram et al. [8] utilized gabor wavelet based filter bank for candidate region extraction while in feature extrac- tion different statistics, intensity and shape based descriptors were used in combination with hybrid classifier based on m-Mediods and Gaussian Mixer Model (GMM).

CLASSIFICATION

Based on the feature vector created the liver segments are classified as either normal or abnormal in the classification stage.
SVMs work on statistical learning theory and can produce robust, accurate and effective results with less number of training samples. In general, the standard binary classifier is trained with the set of data belonging to two different categories and the SVM training algorithm builds a training model that predicts the class for the new given data. However, recently the multiclass problems are also solved by decomposing the multiclass into several binary classes to design a multiple binary SVM classifiers. SVM performs structural risk minimization i.e., a classifier is created with minimized Vapnik and Chervonenkis dimension. Hence, the upper bound of generalization error is predominantly reduced by the low VC dimension. Generalization error is termed as bounds on the error rate of a learning machine on unseen data. These bounds are a function of the training error rate and the terms that measure classifier complexity. To minimize the bounds on the generalization error rate, both the sum of the training error rate and the classifier complexity must be minimized.

TUMOR DETECTION

If the result of classifier is an abnormal one the tumor regions are detected in this module. For this thresholding technique is used. Thresholding is the simplest method of image segmentation. From a grayscale image, thresholding can be used to create binary images. The simplest thresholding methods replace in an image with a black pixel if the image intensity Ii; j is less than some fixed constant T (that is, Ii; j < T), or a white pixel if the image intensity is greater than that constant.

CONCLUSION

The existing systems for tumor detection are not sufficient for obtaining precise results. Many of techniques concentrate on tumor classification from abnormal CT slices. But tumor classification based on a CT is not that much trustworthy. It is confirmed only after many clinical tests. So what we need is a system to classify CT images of liver as normal or abnormal and to detect tumors in the abnormal ones. This work proposes system to classify CT images of liver as normal or abnormal and to detect tumors in the abnormal ones with reduced false positive rate and increased accuracy. This can be used as a second opinion for tumor detection in liver.

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