COMPUTER BASED AUTOMATIC DETECTION AND CLASSIFICATION OF LIVER TUMOR USING MULTILEVEL WAVELET AND NEURAL NETWORKS

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ABSTRACT

Liver cancer or hepatic cancer is a cancer that originates in the liver. Liver cancers are malignant tumors that grow on the surface or inside the liver. Liver tumors are discovered on medical imaging equipment (often by accident) or present themselves symptomatically as an abdominal mass, abdominal pain, jaundice, nausea or liver dysfunction. Liver cancers are cancers that originate from organs elsewhere in the body and migrate to the liver. Many liver cancers are not found until they start to cause symptoms, at which point they may already be at an advanced stage. Many of the signs and symptoms of liver cancer can also be caused by other conditions like High blood calcium levels (hypocalcaemia), Low blood sugar levels (hypoglycaemia), Breast enlargement (gynecomastia), High counts of red blood cells (erythrocytosis) High cholesterol levels, the detection of the liver Tumor is a challenging problem, due to the structure of the Tumor cells. This project presents a segmentation method, K-Means clustering algorithm, for segmenting Magnetic Resonance images to detect the liver Tumor in its early stages. The probabilistic neural network will be used to classify the stage of liver Tumor that is benign, malignant or normal. The experimental result shows that the Clustering based segmentation results are more accurate and reliable than segmentation through thresholding methods in all cases. Probabilistic Neural Network with image and data processing techniques was employed to implement an automated liver Tumor classification.

Key Words: Gray level co-occurrence matrix(GLCM), K-mean clustering, Magnetic resonance imaging(MRI), Probabilistic neural networks(PNN).

INTRODUCTION

Liver cancer is life threatening and occurs without pre-warning, considered one of the most common internal malignancies worldwide. Abnormal growths on the liver are called liver tumours, which could be both benign and malignant. Benign tumour do not really cause harm to one's health.
whereas malignant tumours can be dangerous. Hence, it is necessary to detect and diagnose malignant tumours, discussed by S.S. Kumar, R.S. Moniet al [1], so that early treatment can save many lives. Segmentation of liver tissues in nervous tissue, nerve tissue and growth on medical pictures isn't solely of high interest in serial treatment observation of “disease burden” in medicine imaging. The manual analysis of the tumor samples is time overwhelming, inaccurate and needs intensive trained person to avoid diagnostic errors E-Liang Chen, Pau-Choo Chung et al [2]. Taking the parameters into considerations we propose an automatic detection algorithm consists of effective segmentation techniques and database implementation. Focusing on this two parameters we aim a automating the liver tumor using multilevel wavelet and neural networks in matlab.

ALGORITHM DESIGN

The automated disease identification system is not a single process. This system consists of various modules the success rate of each and every step is highly important to ensure the overall high accurate outputs. the rest of the work is organized as follows

![Algorithm processing steps](image-url)

**Fig:1 Algorithm processing steps**
The Query Image or Input Image is the image on which we will perform the search using the models in the database. The database images can be MRI or CT scan images. So our algorithm focuses on the liver tumor images which can be of either of the types used for analysis of liver tumor.

The database is the collection of various image samples of CT or MRI of different stages of liver tumor images. It includes various severity levels of liver tumors [3,4]. Liver tumor samples are collected from Indo American cancer hospital from Oncology department, Banjara Hills, Hyderabad. This images are considered as reference images for the analysis of liver tumor. The effective tumor analysis depends upon the number of database images.

For images, there exist an algorithm similar to the one-dimensional case for two-dimensional wavelets and scaling functions obtained from one-dimensional ones by tensorial product. This kind of two-dimensional DWT leads to a decomposition of approximation coefficients at level $j$ in four components: the approximation at level $j + 1$, and the details in three orientations (horizontal, vertical, and diagonal)[5]. The discrete wavelet transform is obtained by applying complementary low-pass and high-pass filters and subsequent decimation ($H$ and $L$). Both $H$ and $L$ are applied to data vector $x_1, x_2, ..., x_8$. The output of $H$ is the four wavelet coefficients for the first resolution; the output of $L$ is the four coefficients of the scaling function. The wavelet coefficients of the other resolution levels are obtained by iterating the low- and high-pass filtering steps on the coefficients of the scaling function.

Feature extraction is a special form of dimensionality reduction. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant [6]. Then the input data will be transformed into a reduced representation set of features, named features vector. Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the full input data in order to perform the desired task using this reduced representation instead of the full size input. By using feature extraction we can estimate the parameters of liver tumour like entropy, energy, contrast and correlation.

Probabilistic (PNN) and General Regression Neural Networks (GRNN) have similar architectures, but there is a fundamental difference. Probabilistic networks perform classification where the target image is categorical, whereas general regression neural networks perform regression where the target image is continuous [7]. If you select a PNN/GRNN network, DTREG will automatically select the correct type of network based on the type of target image.

After applying probabilistic neural networks the cancer samples are classified according to the severity [8] and they are named as benign (not harmful) and malignant (harmful). This classification is done with comparison of database images.
SEGMENTATION

Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels) R. Adams, L. Bischof et al. [9]. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyse. Image segmentation is typically used to locate objects and boundaries in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image L. L. Wu, M. S. Yang et al. [10]. Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristics. It is applied to a stack of images, typically in medical imaging.

RESULT

The following figures shows the results by specifying detection, classification and area calculation to detect and analyze the liver tumor.

Table 1: The table shows various samples of performance graphs, area of tumor and type of cancer for liver tumor

<table>
<thead>
<tr>
<th>TEST IMAGES</th>
<th>PERFORMANCE GRAPH</th>
<th>AREA OF TUMOR IN mm.sq</th>
<th>TYPE OF CANCER</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Image 1" /></td>
<td><img src="graph1" alt="Graph 1" /></td>
<td>5.3910</td>
<td>benign</td>
</tr>
<tr>
<td><img src="image2" alt="Image 2" /></td>
<td><img src="graph2" alt="Graph 2" /></td>
<td>4.3460</td>
<td>benign</td>
</tr>
<tr>
<td><img src="image3" alt="Image 3" /></td>
<td><img src="graph3" alt="Graph 3" /></td>
<td>0.5280</td>
<td>benign</td>
</tr>
<tr>
<td><img src="image4" alt="Image 4" /></td>
<td><img src="graph4" alt="Graph 4" /></td>
<td>No tumor area detected</td>
<td>normal</td>
</tr>
<tr>
<td><img src="image5" alt="Image 5" /></td>
<td><img src="graph5" alt="Graph 5" /></td>
<td>No tumor area detected</td>
<td>normal</td>
</tr>
<tr>
<td><img src="image6" alt="Image 6" /></td>
<td><img src="graph6" alt="Graph 6" /></td>
<td>No tumor area detected</td>
<td>normal</td>
</tr>
<tr>
<td><img src="image7" alt="Image 7" /></td>
<td><img src="graph7" alt="Graph 7" /></td>
<td>No tumor area detected</td>
<td>normal</td>
</tr>
</tbody>
</table>
CONCLUSION

In summary a medical system for the automatic detection of primary signs of liver tumor has been developed by maintaining the effective database which addresses the area of tumor and type of severity. The results demonstrated with various samples of CT and MRI liver tumor images and this algorithm proven to be well suited in compliment the screening of liver tumor helping the oncologists in their daily practice.

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REFERENCES


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