

# Feature Based Detection Of Liver Tumor Using K-Means Clustering And Classifying Using Probabilistic Neural Networks

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## Abstract:

Liver cancer is a chronic cancer which originates in the liver. The tumor may be originated elsewhere in the body but latter it migrates towards the liver and makes severe damage to it. In many cases it could not be possible to identify the intensity but symptomatically abdominal pain, jaundice, dysfunction of liver will lead to found its presence. 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. Treatment of any cancer mainly depends on tumor size and grading. Hepatocellular carcinoma is the most common type of liver cancer. The best method of diagnosis involves CT scan of abdomen, it provides accurate results. This proposed method includes segmentation and K-means clustering for segmenting the computed tomography (CT) images, and probabilistic neural network is used to detect the tumor in the earlier stages.

**Key words:** *k-means clustering, hepatocellular, computed tomography (CT), probabilistic neural networks (PNN).*

## 1. INTRODUCTION:

Liver cancer is a chronic cancer which originates in the liver. Basically cancer has 2 phases, benign which is earlier stage and malignant which is advanced stage. These can be identified in diagnosis with special medical equipments. Liver tumor is presently the most advancing and one of the most prevailing cancers in the world. Generally tumors will be developed inside the body tissues without any pre-intimation. The benign type of tumors is of the initial stage tumors and they cause no harm but there is other type called malignant which is the advanced stage. So the detection and diagnosing of malignant tumor is very important and can be studied from S.S.Kumar, R.S.Monietal. 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

very efficiently trained persons to avoid diagnostic errors. So based on all these parameters into consideration, we propose a computer based approach of detecting these tumors and its stage.

k-means clustering is a method of vector quantization, originally from signal processing, that is popular for cluster analysis in data mining. k-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. This results in a partitioning of the data space into Voronoi cells. Hepatocellular carcinoma (HCC, also called malignant hepatoma) is the most common type of liver cancer. Most cases of HCC are secondary to either a viral hepatitis infection (hepatitis B or C) or cirrhosis (alcoholism being the most common cause of liver cirrhosis).

Treatment options of HCC and prognosis are dependent on many factors but especially on tumor size and staging. Tumor grade is also important. High-grade tumors will have a poor prognosis, while low-grade tumors may go unnoticed for many years, as is the case in many other organs.

HCC is a relatively uncommon cancer in the United States. In countries where hepatitis is not common, most cancers of the liver are not primary HCC but metastasis (cancers spread from elsewhere in the body such as the colon). Hepatocellular carcinoma may present with yellow skin, bloating from fluid in the abdomen, easy bruising from blood clotting abnormalities, loss of appetite, unintentional weight loss, abdominal pain especially in the right upper quadrant, nausea, vomiting, or feeling tired.

Computed tomography (CT) is an imaging procedure that uses special x-ray equipment to create a series of detailed pictures, or scans, of areas inside the body. It

is also called computerized tomography and computerized axial tomography (CAT) scanning. X-ray computed tomography (X-ray CT) is a technology that uses computer-processed X-rays to produce tomographic images (virtual 'slices') of specific areas of a scanned object, allowing the user to see inside the object without cutting. Digital geometry processing is used to generate a three-dimensional image of the inside of the object from a large series of two-dimensional radiographic images taken around a single axis of rotation. Medical imaging is the most common application of X-ray CT. Its cross-sectional images are used for diagnostic and therapeutic purposes in various medical disciplines. As X-ray CT is the most common form of CT in medicine and various other contexts, the term computed tomography alone (or CT) is often used to refer to X-ray CT, although

other types exist (such as positron emission tomography [PET] and single-photon emission computed tomography [SPECT]). Older and less preferred terms that also refer to X-ray CT are computed axial tomography (CAT scan) and computer-aided/assisted tomography. X-ray CT is a form of radiography, although the word "radiography" used alone usually refers, by wide convention, to non-tomographic radiography.

CT produces a volume of data that can be manipulated in order to demonstrate various bodily structures based on their ability to block the X-ray beam. Although, historically, the images generated were in the axial or transverse plane, perpendicular to the long axis of the body, modern scanners allow this volume of data to be reformatted in various planes or even as volumetric (3D) representations of structures.

Although most common in medicine, CT is also used in other fields, such as nondestructive materials testing. Another example is archaeological uses such as imaging the contents of sarcophagi. Individuals

responsible for performing CT exams are called radiographers or radiologic technologists and are required to be licensed in most states of the USA. Usage of CT has increased dramatically over the last two decades in many countries. An estimated 72 million scans were performed in the United States in 2007. One study estimated that as many as 0.4% of current cancers in the United States are due to CTs performed in the past and that this may increase to as high as 1.5 to 2% with 2007 rates of CT usage; however, this estimate is disputed, as there is not a scientific consensus about the existence of damage from low levels of radiation. Kidney problems following intravenous contrast agents may also be a concern in some types of studies.

A probabilistic neural network (PNN) is a feed forward neural network, which was derived from the Bayesian network and a statistical algorithm called Kernel Fisher discriminant analysis. It was introduced by D.F. Specht in the early 1990s. In a PNN, the operations are organized into a multilayered feed forward network with four layers:

- Input layer
- Hidden layer
- Pattern layer/Summation layer
- Output layer

PNN is often used in classification problems. When an input is present, the first layer computes the distance from the input vector to the training input vectors. This produces a vector where its elements indicate how close the input is to the training input. The second layer sums the contribution for each class of inputs and produces its net output as a vector of probabilities. Finally, a compete transfer function on the output of the second layer picks the maximum of these probabilities, and produces a 1 (positive identification) for that class and a 0 (negative identification) for non-targeted classes.

The techniques used here are the image segmentation, artificial intelligence of neural networks (PNN), a collection of CT liver images as database and discrete wavelet transformation technique. Focusing on these parameters we aim a

automating the liver tumor using multilevel wavelet and neural networks in MATLAB.

## 2. PROPOSED ALGORITHM:

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. Step by step procedure is shown in Fig 1.

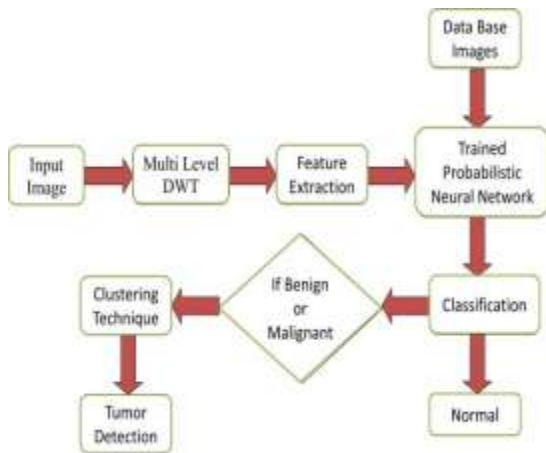


Fig 1: A schematic representation of the algorithm

### Input Image:

The Input Image is the image on which we will perform the research using the models in the database. The data base images can be CT scan images. This algorithm is mainly focused on the liver tumor images which can be used for analysis of liver tumor.

### Data Base Image:

The database is the collection of various image samples of CT of different stages of liver tumor images. It includes various severity levels of liver tumors. Live tumor samples are collected from Sri Swami Jnanananda Spiral C.T Scan Center Bhimavaram and some of the other scanning centers in Bhimavaram. These images are considered as reference images for the analysis of liver tumor. The effective tumor analysis depends upon the number of data base images.

### Multi-level Discrete Wavelet Transform:

Wavelet Transform is a type of signal representation that can give the frequency content of the signal at a particular instant of time or spatial location. The Lifting based wavelet transform decomposes the image into different sub band images, It splits component into numerous frequency bands called sub bands. They are LL, LH, HL, and HH sub bands. A high-frequency sub band contains the edge information of input image and LL sub band contains the clear information about the image.

If the above decomposition will be done for more than two times it is called as a multi-level wavelet transformation. To extract the texture features effectively which are used in classification using PNN we need this multi-level transformation.

### Features Extraction:

Features extraction is a special form which is used to reduce the dimension of the images. When the given input image is too large to process then this technique is used. Then for this processing we convert the image into a reduced set of features called features vector and this conversion is called feature extraction. These reduced features represent the exact information of the input image. By these we can find the parameters like energy, contrast, entropy and correlation.

### Probabilistic Neural Network:

Performance of the PNN classifier was evaluated in terms of training performance and classification accuracies. Probabilistic Neural Network gives fast and accurate classification and is a promising tool for classification of the tumors. Existing weights will never be alternated but only new vectors are inserted into weight matrices when training. So it can be used in real-time.

Since the training and running procedure can be implemented by matrix manipulation, the speed of PNN is very fast.

The network classifies input vector into a specific class because that class has the maximum probability to be correct. In this paper, the PNN has three layers: the Input Layer, Radial Basis Layer and the Competitive layer. Radial Basis Layer evaluates vector distances between input vector and row weight

vectors in weight matrix. These distances are scaled by Radial Basis Function nonlinearly. Competitive Layer finds the shortest distance among them, and thus finds the training pattern closest to the input pattern based on their distance.

**Segmentation:**

Image segmentation is the process of partitioning a sets of pixels, also known as super pixels (R. Adams, L .Bischofetal [9]). The main aim of segmenting is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and its boundaries L. L. Wu, M. S. Yangetal [10]. Every image will have some areas of same parameters like intensity or color, etc., so basing the similarity in the pixels we identify those areas with same parameters. So that we can have a simpler way to analyze the information from the image. There are many segmentation techniques. Here we used the K-Means clustering method for this purpose and is done based on intensities of the pixels.

**3. CLASSIFICATION OF TYPE OF CANCER:**

After applying the image to the PNN then it will get classified into a type of cancer based on the parameters calculated. There are mainly three types based on the severity they are benign, malignant and a normal liver.

**RESULTS:**

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

The various samples of performance graphs, area of tumor and type of cancer for liver tumor are shown in Table 1.

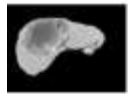
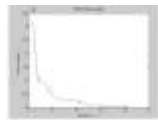
















Test Images	Performance Graph	Areaof Tumor In mm.sq	Type of Cancer
		19.5788	BENIGN
		17.3799	BENIGN
		17.4919	MALIGNANT
		8.3568	MALIGNANT
		13.3287	MALIGNANT
		19.2467	MALIGNANT
		No tumor area detected	NORMAL
		No tumor area detected	NORMAL
		No tumor area detected	NORMAL

Table1: showing results for different CT images.

#### 4. CONCLUSION:

In this approach, it is very simple to identify the stage and the affected tumor area in the liver tissue. This can be made further effective by improving the database number by including all the types of tumor images into the database. The above results displayed are by using CT image of the organ and they are widely useful for the oncologists in the detection of tumor.

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