AN EXPERT SYSTEM FOR DETECTING STAGES IN LUNG CANCER

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Abstract- Lung cancer is the common cause of death among people. Detection of the tumor at the early stage can increase the chance of survival. Survival rate for lung cancer patients can increase from 14% to 49% if the disease is detected in time. Problem seemed to be increased while using x-ray for detection of tumor in lung cancer. Computed tomography is more efficient than x-ray. Hence, a lung cancer detection system using image processing is designed to classify the presence of lung cancer in ct-images. MATLAB have been used in all the procedures. In image processing, image pre-processing, segmentation and feature extraction processes has been implemented. Then the extracted features are given as input to the fuzzy system where a rule base is created and the fuzzy system provides the information about the stages of lung cancer.

Keywords: Segmentation, Thresholding, fuzzy, CT

I. Introduction

Tumor is formed due to the multiplication of abnormal cell multiplication which certainly leads to lung cancer. The mortality rate of lung cancer is the highest among all other types of cancer. One of the most serious cancers in the world is lung cancer with the smallest survival rate after the diagnosis, with a gradual increase in the number of deaths every year. A lung cancer patient chance of survival is based on the size of tumor at the detection time. Cluster of abnormal cells forms tumor and the nearby normal cells gets affected. This abnormal cell spreads to other parts of the lung through lymph nodes. Lung cancer is divided into non-small cell cancer and small cell cancer. Stage 1 belongs to small cell cancer and stage 2 and 3 belongs to non-small cell cancer. As for the stages, in general there are three stages of lung cancer; I through III. Staging is based on tumor size. Presently, CT are said to be more effective than plain chest x-ray in detecting and diagnosing the lung cancer. Since, the x-ray also provides the information about the ribs and so detection of small sized tumor is impossible. An estimated 85 percent of lung cancer cases in males and 75 percent in females are caused due to cigarette smoking. Objective of this study is to detect lung cancer using image processing techniques. CT scanned lung images of cancer patients are acquired from various hospitals. Using image processing techniques like pre-processing and feature extraction, area of interest is segmented. Features like area, perimeter and eccentricity are extracted from the image. The parameter values obtained from these features are compared with the values suggested by a physician.
From the comparison result, cancer stage is detected. This system can help in early detection of lung cancer more accurately.

II. Literature Survey

Researchers developed many methods to diagnose lung cancer. An expert system is designed to diagnose the heart disease and is based on fuzzy logic it uses the dataset. All the symptoms are considered and membership function is calculated for both input and the output variable. Finally, a rule base is created and rules are framed based on the symptoms of the patient. This system only provides information about the disease but not about stage and treatment. A fuzzy Expert system is developed to determine coronary heart disease risk of patients and gives the user the ratio of the risk for normal live, diet and drug treatment. A Fuzzy rule based lung disease diagnostic system combining the positive and negative knowledge was developed using contexts, facts, rules, modules and strategies of knowledge representation to identify medical entities and relationship between them for diagnosis of lung cancer.

An Intelligent system for Lung cancer diagnosis is designed that detects all possible lung nodules from chest radiographs using image processing techniques and feed forward neural networks. It classifies the nodules into cancerous and non-cancerous nodules. The main purposes of the modified c-means radial basis functions are to diagnose the cancer diseases by using fuzzy rules with relatively small number of linguistic labels, reduce the similarity of the membership functions and preserve the meaning of the linguistic labels. For patients with lung cancer, induction of high-risk cytochrome p450 genotypes may accelerate catabolism of volatile organic compounds that are excreted in the breath, so that their abundance in breath may provide biomarkers of lung cancer. In PET/CT Images, the exact position of boundary of the tumor was manually identified, five optimal threshold features and two gray level threshold features of the tumors were extracted from the B-mode ultrasonic images, an optimal feature vector was obtained using K-means cluster algorithm and a back propagation, artificial neural network was applied to classify lung tumors. Dynamic tumor-tracking irradiation treats the lung as an elastic object and analyzes the deformation based on linear Finite Element Method. In Intelligent medical chromatic image understanding system for lung cancer cell identification based on fuzzy knowledge representation and reasoning, image analysis and a low-level feature extraction process follows a two-layer rule-based fuzzy knowledge model to represent the domain knowledge needed for image understanding task. The previous papers on medical diagnosis present data mining techniques using case based reasoning, genetic algorithms and many other methods for pattern recognition. These systems are highly accurate and provide information in a wide range of formats (text, images, clusters etc.) but are very complex and difficult to be implemented. The system proposed in this paper is very simple and the implementation is very easy. Computational study in medical diagnosis is still simpler but accurate systems are the need of the day.

III. Proposed Work

Overall, there are three main processes used throughout the report are pre-processing, feature extraction and classification process. MATLAB is used in every process. Process involved in the lung cancer detection system for the project can be viewed in Figure.
Image Acquisition: First step is to acquire the CT scan image of lung cancer patient. The lung CT images are having low noise when compared to X-ray and MRI images; hence they are considered for developing the technique. The main advantage of using computed tomography images is the detection of small sized tumor is easy.

Smoothing: Smoothing is performed to reduce noise induced in the image and also all other fluctuations. It also blurs all sharp edges that bear important information about the image. To remove the noise from the images, wiener filtering is used. Wiener filtering is a non-linear operation often used in image processing to reduce Gaussian noise.

Thresholding: Before Thresholding, processes such as dilation and erosion are performed. Then the border is cleared using clear border function. Then Thresholding is performed using the gray thresh function.

Feature Extraction: For classifying the stages some features are extracted in order fetch some input to the fuzzy system. The basic characters of feature are area, perimeter and eccentricity. These are measured in scalar. These features are defined as follows:

A) Area: It is the scalar value that gives actual number of overall nodule pixel in the extracted ROI.
B) Perimeter: It is a scalar value that gives actual number of the nodule pixel. It is the length of extracted ROI.
C) Eccentricity: It is used to decide the shape or circularity of the object.

Fuzzy System: Information gathered from the doctors is transferred to knowledge. This knowledge is incorporated in the form of fuzzy model in the detection and diagnosis of lung cancer. The extracted features such as area, perimeter and eccentricity of the image are given as input to the fuzzy system. Membership function is calculated for both input and output variables. Finally, a rule base is created and based on the parameters extracted from the image rules are framed and the fuzzy system provides the information about the stages of lung cancer.

IV. RESULTS

Stage 1:
Stage 3:

<table>
<thead>
<tr>
<th>Stages/Parameters</th>
<th>Area</th>
<th>Perimeter</th>
<th>Eccentricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage1</td>
<td>70.25</td>
<td>30.1421</td>
<td>0.3951</td>
</tr>
<tr>
<td>Stage2</td>
<td>867.5</td>
<td>119.598</td>
<td>0.7103</td>
</tr>
<tr>
<td>Stage3</td>
<td>1195.4</td>
<td>166.124</td>
<td>0.7132</td>
</tr>
</tbody>
</table>

The CT images are acquired from NIH/NCI Lung Image Database Consortium (LIDC) dataset. We have used about 60 samples for classifying the tumor(20 samples for each and every stage).

The main feature of this system is that we can perform easy modification and continuous updating of the database. The main challenges in this proposed work is to provide accurate result to the patient and to make them aware of lung cancer in the early stage itself. The accuracy can be increased by implementing more analysis techniques on the same database used in the system along with the current algorithm.

V. CONCLUSION

The developed system yields optimal result and serves as an expert medical diagnosis system even for ordinary users since it is simple and easy to implement. This system is useful to the physician as well as the user for determining the stage of lung cancer. The main feature of this system is that we can perform easy modification and continuous updating of the database. The main challenges in this proposed work is to provide accurate result to the patient and to make them aware of lung cancer in the early stage itself. The accuracy can be increased by implementing more analysis techniques on the same database used in the system along with the current algorithm.

VI. REFERENCES
