

Detection and Feature Extraction of Cancer Nodules in Lung CT Image

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Abstract:

Treatment of lung cancer is successful only if it is detected in its early stage. The most interesting research area of researcher's is the detection of lung cancer in early stages as it helps in degrading the death rates. Since there is an immense distinction between technical and clinical research sectors, people are not aware about this disease. In technical research, image processing techniques are widely used to get the better output images. Images used in lung research areas are CT scan and MRI images. This proposed system has considered CT image as input and then this input is processed further using different techniques such as preprocessing, segmentation and feature extraction. In preprocessing, filters like median, gabor, wiener, Gaussian and anisotropic filters are used which give relatively better preprocessing output. Segmentation is the next step which is applied to the preprocessed image and it converts the representation of image into a more meaningful image. Thresholding, K-mean clustering and fuzzy C means are used as segmentation techniques. From the segmentation output, detection of lung cancer can be easily done. Feature extraction is the last essential step which gives area, perimeter, length of major axis and minor axis of the detected cancer nodules. Thus, survival rate of a person suffering from lung cancer is directly proportional to its early detection.

Keywords:

Median filter, Gabor filter, Wiener filter, Gaussian filter, Anisotropic filter, Thresholding, K-mean clustering, fuzzy c-mean and feature extraction.

Introduction:

The cancer of the bronchus is also called as lung cancer and is classified by uncontrollable growth of cell in lung tissues. It is primarily caused due to the presence of carcinogenic agents. The major cause of death from cancer among people having ages 40-65 is lung cancer. Every year more than 30% of the people are killed by the lung cancer which is much more than the death rates caused by the combination of colon, breast and prostate cancers. Many techniques already exist to detect whether lung cancer is present or not. But these techniques are time consuming and expensive. These techniques are MRI scan, CT scan, Sputum cytology and X-Ray. A new technique was needed to detect the presence of lung cancer which should be less time consuming. Thus, image processing is such technique with good quality control to detect whether lung cancer is present or not.

Several methodologies are used to reduce the death rates causing due to lung cancer and detect the symptoms in its early stage. Drinking alcohol, chewing of tobacco and smoking cigarettes cause lung cancer. The people falls on the age group of 25-60 smoke regularly thereby increasing the percentage of death rate caused by lung cancer. The development of cancer also depends on passive smoking for this particular age group considerably in high figure. Also, a report has been published in Nov 2017 by Berkeley Earth science Research Group that breathing in Delhi air is equivalent to smoking 44 cigarettes a day. Therefore, exposure to a large amount of PM 2.5 in cosmopolitan city like Delhi is the utmost cause of cancer.

In this paper, image processing techniques such as preprocessing, segmentation and feature extraction is applied to an input image to get the better output image so that cancer nodule can be easily detected. Filters such as median, gabor, wiener, gaussian and anisotropic come under preprocessing techniques of an image. K-mean clustering, thresholding and Fuzzy C-means come under segmentation process [1] [3] [4]. Feature extraction includes area, perimeter and length of major axis and minor axis of the detected cancer nodule. Any of the images from CT scan or MRI can be taken as input.

Literature Survey:

Nowadays, digital image processing techniques are extensively used in medical and research sectors to detect the disease at early stage. The review of papers related to topic as follows:

Pooja R. Katre et.al proposed a system in which CT scan image was taken as input image which is readily available in online database [1]. These files are not directly accessible so these were first converted to readable format. Median filter was used for smoothing and high boost filter was used for image enhancement. For segmentation, marker controlled watershed was used.

Ratih Wulandari et.al proposed a system in which axial plane lung CT-scan was taken as input image which can be directly accessible [2]. Erosion and dilation were used as preprocessing techniques. Before preprocessing techniques, the gray level was recorded to create template of cancer color.

Prionjit Sarker et.al proposed a system in which CT scan image as dicom format from the database TCIA [3] was used. In preprocessing, erosion and dilation along with opening and closing techniques were used. K-means clustering algorithm was used for segmentation purpose.

Anjali Kulkarni et.al used the CT scan image in dicom format taken from the online database (LIDC) [4]. Primarily, median filter was used for image smoothing and gabor filter was used for image enhancement. Marker based water technique was used for segmentation.

Shraddha G. Kulkarni et.al proposed a system in which input image was CT scan in dicom format taken from the online database (ELCAP) [5]. Initially, gaussian filter was used for image smoothing and anisotropic filter was used for image enhancement. Watershed technique was used for segmentation.

Methodology:

This proposed system consists of basically four steps starting from acquisition of lung CT-scan images to feature extraction. The block diagram of proposed system is shown in Figure 1. CT scan image is taken as input. Preprocessing techniques are applied for smoothing and enhancement of input image by using any of the filters among median, wiener and gabor filter. Segmentation is the next essential step which involves techniques like k-mean and fuzzy c-means. The third and final step is the feature extraction which gives area, perimeter and, length of major and minor axis.

The processing of image is done by the following steps:

1. Acquisition of CT scan image.
2. Image preprocessing.
3. Image segmentation
4. Feature extraction

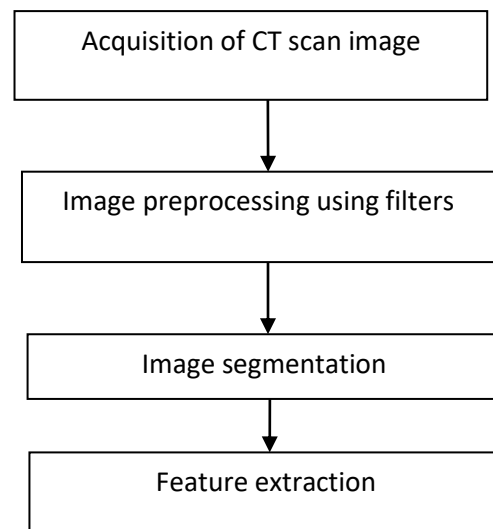


Figure1: Block diagram

Description of each step is given below:

Acquisition of image: First step is to read a CT scan image. Then it is processed further for the next step.

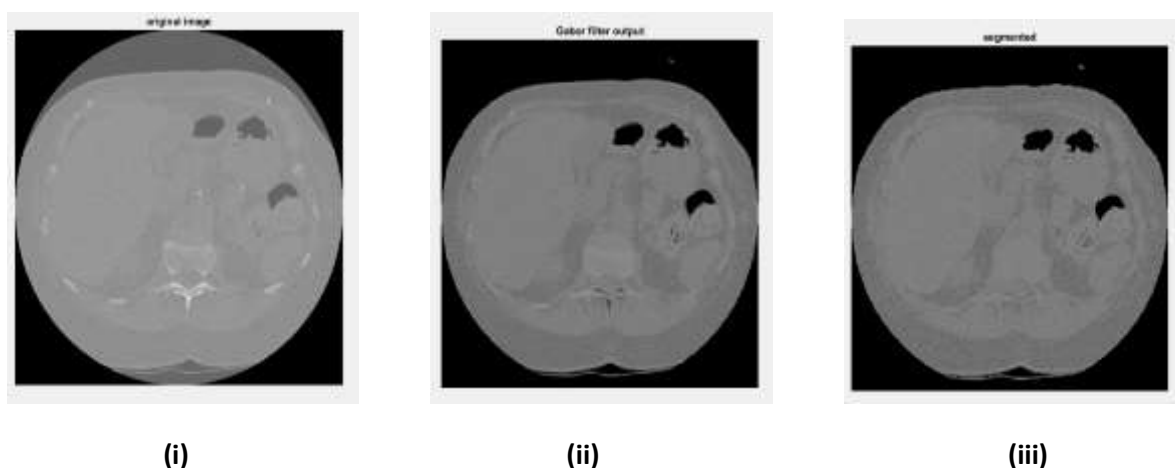
Image preprocessing using filters: Filtering techniques among median, wiener and gabor are applied to enhance the visibility of input image.

Image segmentation: It involves the partitioning of an image into multiple segments so that the output image can be more meaningful and easily analyzed.

Feature extraction: The segmented image is finally subjected to extract the features such as area, perimeter, and length of major and minor axis of the detected cancer nodule. Also, these features can be extracted for more than one cancer nodule.

Results:

The output of CT scan image for preprocessing and segmentation techniques of block diagram is shown below:



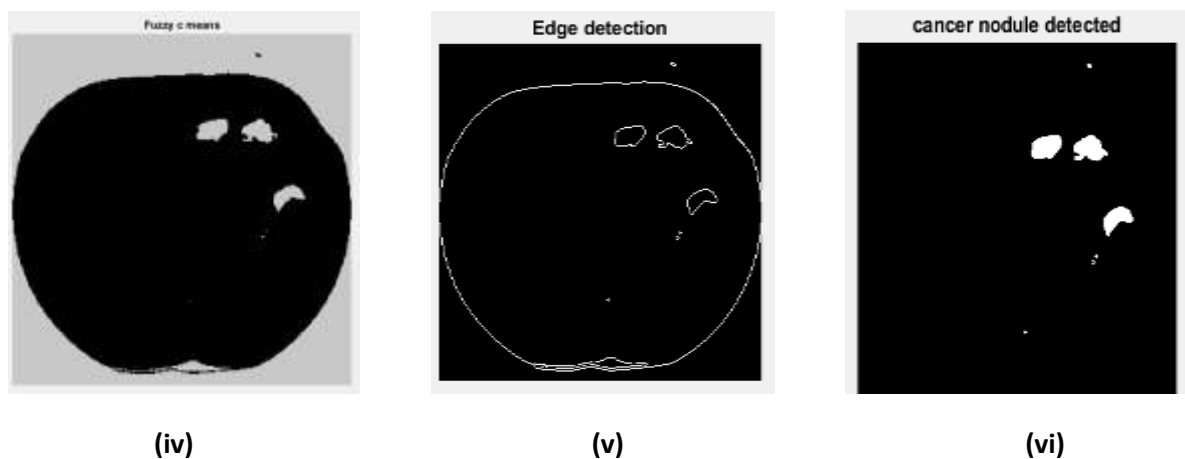


Figure1: Figures showing the output of different stages of proposed model (i) Input image (ii) Gabor filter output (iii) K-means output (iv) Fuzzy c-mean output (v) Edge detection output (vi) Detected nodules.

The proposed method gives the detection of lung cancer nodules using suitable filtering and segmentation techniques. The input CT scan image is enhanced using gabor filter. K-mean and fuzzy c-mean is then applied to the filtered image which emphasize on the better visibility of cancer nodule. There may be one or more cancer nodules that grow inside the lungs. As the cancer nodules are detected, they are separated from the lung walls to extract the features such as area, perimeter, and length of major axis and minor axis.

The output of feature extraction from the detected cancer nodules is given below in tabular form.

Nodule	Area	Perimeter	Major Axis Length	Minor Axis Length
1 st	29	58.66	33.5774	5.4183
2 nd	5	5.6240	2.7809	2.7809
3 rd	316	65.1360	26.5261	15.3882
4 th	322	84.6430	26.4324	16.8947
5 th	10	8.1460	4.5314	2.9212
6 th	5	9.1800	3.7594	3.2083
7 th	5	5.6240	2.7809	2.7809

Table1: Table showing features of different cancer nodules

The above table shows the features such as area, perimeter, major axis length and minor axis length of the detected cancer nodules.

Conclusion and Future work:

Image processing techniques helps in sharpening and enhancing the images. Also, it helps in extracting the features such as area, perimeter, length of major and minor axis. By knowing the features of nodules, we can determine the size. If the size of cancer nodule is small, it means a person suffering from early stage cancer and if the size of cancer nodule is too big, it means a person suffering from large stage cancer

In future work, we can make a classification of lung nodules having features like area, perimeter, length of major and minor axis, eccentricity and volume. In this classification, we can use the existed standard values of the above mentioned features derived by doctors and lung cancer researchers along with the different stages like early, middle and last. These values should be compared with the proposed system values and the stage of lung cancer can be detected.

References:

- [1] Pooja R. Katre and Dr. Anuradha Thakare, Detection of Lung Cancer Stages using Image Processing and Data Classification Techniques, 2017 IEEE 2nd International Conference for Convergence in Technology (I2CT).
- [2] Ratih Wulandari, Riyanto Sigit and Setia Wardhana, Automatic Lung Cancer Detection Using Color Histogram Calculation, 2017 IEEE International Electronics Symposium on Knowledge Creation and Intelligent Computing (IES-KCIC).
- [3] Prionjit Sarker, Md. Maruf Hossain Shuvo, Zakir Hossain and Sabbir Hasan, Segmentation and Classification of Lung Tumor from 3D CT Image using K-means Clustering Algorithm, 2017 IEEE 4th International Conference on Advances in Electrical Engineering (ICAEE).
- [4] Anjali Kulkarni, Anagha Panditrao, Classification of Lung Cancer Stages on CT Scan Images Using Image Processing, 2014 IEEE International Conference on Advanced Communication Control and Computing Technologies (ICAC-CCT).
- [5] Shraddha G. Kulkarni and Sahebrao B. Bagal LUNG CANCER TUMOR DETECTION USING IMAGE PROCESSING AND SOFT COMPUTING TECHNIQUES 2016, International journal of science technology and management.
- [6] Ritika Agarwal, Ankit Shankhadhar, Raj Kumar Sagar , "DETECTION OF LUNG CANCER USING CONTENT BASED MEDICAL IMAGE RETRIEVAL," 2015 5th International Conference on Advanced Computing and Communication Technologies
- [7] Nastaran Emaminejad, Wei Qian, Yubao Guan, Maxine Tan, Yuchen Qiu, Hong Liu, and Bin Zheng, "Fusion of Quantitative Image and Genomic Biomarkers to Improve Prognosis Assessment of Early Stage Lung Cancer Patients," , VOL. 63, NO. 5, MAY 2016 IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING
- [8] P.B.Sangamithraa, S.Govindaraju, "Lung Tumour Detection and Classification using EK-Mean Clustering," 2016 IEEE WiSPNET.