ISSN : 2591-7951

Challenges in lung cancer detection using computer-aided diagnosis (CAD) systems – a key for survival of patients.

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Accepted on May 18, 2017

Cancer is calculated to be the second main reason for deaths worldwide [1, 2]. Unrestrained development and extend of cells lead to cancer and finally results in death [3]. Among all the cancerous deaths recorded, lung cancer is the primary root of cancer deaths in men; however, it ranked ninth position in women cancer deaths [4]. However in women, breast cancer is the primary root of cancer deaths. It is possible to detect the cancer at a very early stage, providing a much higher chance of survival for the patients [5, 6].

Lung cancer may be diagnosed using Computer-Aided Diagnosis (CAD) systems by following methods:

1. Diagnosis through the symptom values from the patients;
2. Diagnosis through Computed Tomography (CT) images of patient.

Challenges in Diagnosis through the Symptom Values

The existing lung cancer diagnosing systems using CAD systems for the symptoms based study are suffering with lack of sensitivity, specificity and accuracy. The existing systems were designed with fuzzy rule based systems, neural systems and supervised learning systems. However, in future hybrid techniques using more than two systems as a combination may improve sensitivity, specificity and accuracy in greater value.

Challenges in CT Images

The lung cancer diagnosis in the CT images involves: pre-processing, segmentation of suspected nodules, feature extraction for the suspected nodules and classification of suspected nodules as malignant (cancerous) or non-malignant. Preprocessing is the very first step in all images processing algorithms and focused to remove the noises which occurs in CT images while acquiring. The existing algorithms used mean filter, median filter, Gaussian filter, Weiner filter, min filter, max filter, Gobar filter, etc. After the noise removal from CT images quality of the image is measured using peak signal to noise ratio. Yet there is scope to improve peak signal to noise ratio, after the noise removal from the CT images.

The second step after the noise removal from CT image is the segmentation; it allows us to segment the suspected lung nodules from which final decision on the nodules can be made. Various segmentation techniques such as multiple thresholding, optimal thresholding, global thresholding, filtering based methods, active contour methods, shape-based methods, watershed segmentation, morphological approaches, template matching, level set algorithms were reported in the literatures were reported for the successful segmentation. The existing techniques were reported with more false positives. Still there is scope to reduce the number of false positives.

The third step in lung cancer diagnosis from CT image is the feature extraction; it allows us to determine the unique characteristic for the suspected nodules. Two dimensional (2-D) features such as shape/size features, geometric features, gray level features, gradient features and statistical features were extracted from the suspected nodules for the identification of nodules as malignant or non-malignant in the implemented systems. Yet there is scope to combine 3-D features along with the existing 2-D features in order to reduce the number of false positives.

Final stage in lung cancer diagnosis from CT image is the classification; it allows us to classify the suspected nodules as malignant or non-malignant using extracted features. Rule based classifiers, artificial neural networks, support vector machines, linear discriminant analysis; genetic algorithms were successfully implemented in existing classifiers. However, still there is scope to improve the sensitivity, specificity and accuracy of the existing diagnosis systems.

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