DEVELOPMENT OF A COMPUTERIZED DETECTION SCHEME OF PULMONARY NODULES IN CHEST CT IMAGES

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This thesis aims at developing a Computer Aided Diagnosis (CAD) system used for the detection of lung pulmonary nodules in chest Computed Tomography (CT) images. The addressed lung nodules include both solid and Ground Glass Opacity (GGO) nodules. More interest is given specially to the detection of GGO nodules due to the challenging difficulties encountered in detecting them. The main processing stages involved in the detection algorithm are the same for both types with some suggested modifications in the technical details to suit the nature of each type aside.

At first, it is necessary to identify and locate the potential nodular candidates inside the lung area. Accordingly, the nodular attenuation levels are analyzed to use them as guideline to develop a preprocessing stage aiming primarily at enhancing the intensity values of the nodular regions and meanwhile attenuating the intensity of surrounding parts. To further improve the characterization of the nodular regions, the application of Gabor filter and some morphological characteristic features are studied.

Next, some discriminating procedure is implemented to differentiate the potential nodular candidates from other findings. The discriminating procedure starts with investigating some gray level features that mainly characterize the nodular regions. Then a template matching technique is utilized to measure the similarity between the nodular candidates and some reference nodule-like templates. The discrimination of nodular candidates is concluded by studying the possibility of confirming their presence in the transaxial-view images by examining the corresponding coronal-view images. 2D image-processing techniques are used for fusing the detection results obtained from both transaxial and coronal sectional images to save computational time and avoid the complexity involved in investigating 3D structures.

Finally, in order to reduce the False Positive (FP) rate of the detection scheme, a proposed Radial Basis Function (RBF) neural network is introduced. The main reason behind choosing the RBF network lies in its capability of performing efficiently in pattern classification. The structure and training techniques of the proposed RBF network are discussed in detail; also the effectiveness of the network is investigated by comparing its performance to that of a common multilayer perceptron network.

The proposed CAD scheme provides detection sensitivity of 96.3% with False Positive (FP) rate of 0.06 FP/sectional image in the detection of GGO nodules. These experimental results demonstrate the significant effectiveness of the developed CAD and prove its potential competence in clinical applications.