Cancerous Nuclei Detection on Digitized Pathological Lung Color Images

Karen Fandozzi
Department of Electrical, Biomedical and Computer Engineering
University of Rhode Island, Kingston, RI
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Lung cancer is a serious disease that causes a large number of deaths throughout the entire world. A person who has lung cancer has a much higher chance of recovery when it is detected in its early stages. Currently, there are several techniques to detect it; however, these require a biopsy for a definitive diagnosis.

Cancer cells can be recognized by the morphological and chromatic features of their nuclei regions. This new software package, by Mohamed Sammouda et al., can extract cancerous nuclei regions contained in a pathological color image of lung tissue.

The first step to creating this software was to design a segmentation method. The method for this program is based on an unsupervised Hopfield Neural Network (HNN), which has been found useful for segmentation of cerebral images from MRIs. To use this, the pixels in each image are separated into the three parts in each of the RGB and HSV color spaces. The HNN works by each row representing a pixel and each column representing a cluster. The image is then classified as having N pixels of P features among M classes. After performing this task, and solving a series of equations, the nuclei are classified. Further study shows the HSV color space as having better results than RGB. This is due to environmental effects when the picture is taken.

The next step in developing this software was to develop a labeling algorithm. This algorithm will extract the areas of interest, based now on the green in the RGB color scheme. Green was chosen after studying three randomly chosen images. Three threshold values are used to label the image as: nuclei (threshold = 110), cytoplasm (threshold = 210), or other regions (threshold = 255). After this algorithm is performed, the image can be seen as only nuclei, only cytoplasm or only other regions. Due to the nuclei region showing some holes after the labeling algorithm, the maximum drawing circle algorithm is used to fill in the holes in the nucleus.

The last step is to determine whether the nuclei are cancerous or benign. This technique compares single cell features in respect to their surrounding cells. Also, the amount of cytoplasm around it is tested for abnormalities. However, the main test is the diameter of the nucleus.

This program has shown to extract approximately 96% of cancerous nuclei that a human expert would extract visually. This program is of obvious value in early detection of lung cancer. In addition, the authors of this program plan to generalize it so it may be used for the entire body.

Reference:

Sammouda, Mohamed, et al. "*Cancerous nuclei detection on digitized pathological lung color images*". Journal of Biomedical Informatics. Volume 35, Number 2, April 2002.