Chapter 6
Mobile-Aided Breast Cancer Diagnosis by Deep Convolutional Neural Networks

ABSTRACT

After verifying the capability of deep learning for basic image recognition, this chapter further extends image recognition to App-aided breast cancer diagnosis. Human cancer has been considered as the most important health problem. For medical image recognition of breast cancer, the presented approach is no longer the same as the traditional. It needs no axioms for distinguishing malignant and benign tumors, and no hand-crafted textural descriptors for feature extraction. The goal is to develop a mobile-aided diagnosis system of directly processing raw medical images. It automatically extracts features and learn filters of a deep CNN subject to labelled medical images in advance. This chapter presents a CNN architecture for diagnosing breast cancer images, illustrating effectiveness of problem solving by designing classifiers, respectively diagnosing lobular carcinoma breast cancer against phyllodes tumor and papillary carcinoma against adenosis. The performances of two classifiers for breast cancers diagnosis are separately summarized by the testing accuracy rates of 94.9% and 87.3%.

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BREAST CANCER DIAGNOSIS BY DIRECT MEDICAL IMAGE RECOGNITION

Beyond pattern recognition of handwritten digits and characters, developing intelligent-assisted diagnostic systems is also an interesting problem. In the current society, the laborers are slowly decreasing, whereas the elders are gradually increasing. This problem has spawned expensive labor and high demand for healthcare resources in the future. The pressure on medical staff is also increasing. Therefore, developing the intelligent diagnostic system helps relieve the pressure of the medical staff (Boyle & Levin, 2008) (Lakhani, Ellis., Schnitt, Tan, & van de Vijver, 2012). Today, cancer is the second cause of leading death in the world. The number of people worldwide who died of cancer was about 9.6 million in 2018 (Wold Health Organization, 2018) and will increase to 27 million until 2030 according to prediction in (Boyle & Levin, 2008). Among the 9.6 million cancer deaths, breast cancer is the second common cancer. After verifying the capability of deep learning for basic pattern recognition, we hope to develop the diagnostic system of breast cancer by deep learning of the CNN models.

In fact, research on the development of intelligent diagnosis of breast cancer has been around for a long time, where those based on histopathological analysis are especially important for BC diagnosis (Lakhani, Ellis., Schnitt, Tan, & van de Vijver, 2012). BC diagnosis based on automatic image processes has been also developed over 40 years (Stenkvist, et al., 1978). The previous work in (Kowal, Filipczuk, Obuchowicz, Korbicz, & Monczak, 2013) applies image processes for segmenting nuclei of breast cancer. We can trace back to the Breast Cancer Wisconsin (Original) dataset (Wolberg, Breast Cancer Wisconsin (Original) Data Set, 1992) created by Dr. William H. Wolberg in the 1990s. This data set contains 699 instances, with 458 benign and 241 malignant samples. Each sample is described by nine cytological characteristics, each with an integer ranging from 1 to 10. The cell of the breast mass was obtained via the medical method of fine-needle aspirates (FNAs) for analysis and recorded as benign or malignant by analysis of cytological characteristics. Scientists selected nine characteristics from eleven cytological characteristics of breast FNAs by statistical analysis to differed significantly between benign and malignant masses. The nine characteristics are including cell size, uniformity of cell size, uniformity of cell shape, bare nuclei, normal nucleoli, clump thickness, clump cohesiveness, mitosis and nuclear chromatin (Wolberg & Mangasarian, 1990). In the past, researchers