Detecting Abnormal Regions in Colonoscopic Images by Patch-based Classifier Ensemble

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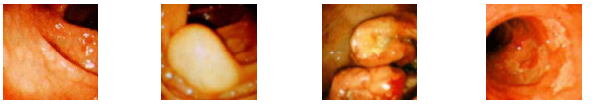
Abstract

In this paper, a new method is proposed to detect abnormal regions in colonoscopic images by patch-based classifier ensemble. Through supervised learning from image patches of various sizes, a set of basic SVM classifiers is trained for each size. A diagnostic model can then be constructed based on the ensemble of basic classifiers which is then used to detect abnormal regions in colonoscopic images. The multiple sizes of patches provide multiple level representation of the image content, which can help improve detection results. Several fusion criteria are explored to determine the final output of the ensemble. Experimental results show promising performance of our proposed method.

1. Introduction

At present, the analysis of colonoscopic images and diagnosis of abnormalities that may manifest cancerous growth relies on the experiences and expertise of the medical experts, which need years of training. Therefore it is justified to develop a computer-assisted technique for screening of this potentially lethal disease. Previous research on colonoscopic image analysis focuses on the classification between normal tissues and tumors. Tjoa *et al* employed back-propagation neural network for colon status classification and proposed using principal component analysis to improve computation efficiency [9]. Since they used full-size colonoscopic images for the classification, classification error can be resulted when the size of abnormal region is small. Maroulis *et al* developed a detection system for colorectal lesions in endoscopy video-frames using multi-layer neural network as a classifier [5]. Recently Karkanis *et al* employed a linear discriminant analysis procedure to detect tumors in endoscopic video using wavelet features [3]. However, to our best knowledge, none of them attempt the discrimination between normal tissues and all different kinds of abnormalities. In fact, there are many kinds of abnormalities that can be seen in endoscopic images, such as polyps, tumors, inflammation, bleeding, ulceration and diverticula, etc.(Figure 1), and their image content show large variations. Furthermore, the normal regions of colonoscopic images also show large variations. The abnormal regions often do not occupy the whole image and are of various color, sizes and shapes. All these make the discrimination between normal and abnormal regions in colonoscopic images a tough job. The abnormal region detection problem in colonoscopic images can be regarded as a perceptual image segmentation problem. Many methods have been developed for computer-assisted segmentation of medical images, such as thresholding, region growing and classification based methods etc [6]. However, almost all of these methods partition the pixels in an image based on low level cues, such as illumination, color, texture, and the segmentation often disagree with the way human-beings partition the image. Therefore, these methods cannot produce a perceptually "good" segmented image. Recently, there are some attempts to segment the images by incorporating higher level knowledge. Shi *et al*. treated image segmentation as a graph partitioning problem and proposed a global criteria called "Normalized Cuts" for segmenting the graph [8]. Motivated by the Normalized Cuts, Ren *et al*. presented a binary classification model for segmentation [7]. Instead of using a single pixel for segmentation, they grouped pixels



polyp lipoma tumor inflammation

Figure 1. Colonoscopic images with different abnormal regions.