ABERRANT CRYPT FOCI SEGMENTATION USING COMPUTATIONAL VISION

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KEYWORDS: Endoscopy Images, Deformable Models, Image Segmentation, Level Sets.

ABSTRACT: *Colorectal cancer is a type of cancer that develops in the large intestine (colon) or the rectum, one of the most common malignancies in the world. In this context, the aberrant crypt foci may have a crucial and decisive role. The aberrant crypt foci are supposed to be the precursors of colorectal cancer. This works aimed to develop computational methodologies for the detection and segmentation of aberrant crypt foci in endoscopy images.*

1 INTRODUCTION

Colorectal cancer is one of the most frequent types of malignancies in the world and one of the leading causes of death. Unlike other tumors, it is possible to prevent colorectal cancer [1]. Hence, it is of great interest the development of complementary diagnostic techniques, in addition to the current ones, to streamline and standardize processes, for an automatic detection of aberrant crypt foci (ACF) that could later lead to colorectal cancer [2]. In fact, the early detection reduces mortality rate and will be beneficial at an economic and social plan in the near future [3].

The main goal of this works was the segmentation of aberrant crypt foci in endoscopy images.

2 ACF BIOLOGY

The colon and rectum are part of the human digestive system [4]. Crypts are part of its epithelium and are responsible for mucus secretion [5]. There is no fixed number of aberrant crypt for its classification on a focus aberrant crypt, but, on average, Fig.1, is about 5 to 35 crypts [6].

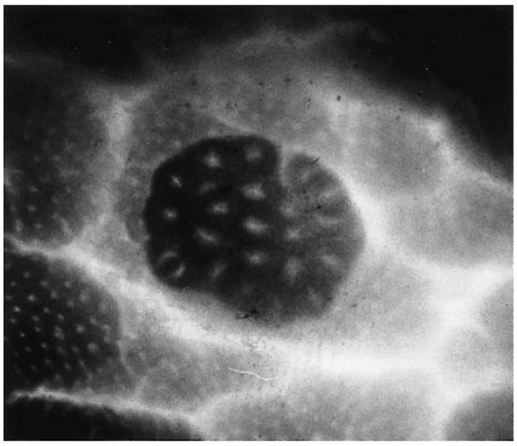

Figure 1 – Aberrant crypt foci containing 25 visible cyprts (adapted from [7]).

Colonoscopy has been the gold standard for screening colorectal cancer and aberrant crypt foci detection [8].

3 METHODOLOGY

The usual image acquisition systems provide color ACF images that are corrupted with noise, air bubbles, shadows and glare caused by the light source used.

The implementation developed was divided into three steps: Image Preprocessing, Feature extraction and Segmentation. The preprocessing step consists in the applications of smoothing filters: Median and Gaussian filtering were chosen in order to remove noise and maintain the interesting borders. The feature extraction phase is to attain the desired image characteristics, and includes color mapping, glare removal and contour detection. For the image segmentation, level sets were used [9] as well as a new region growing algorithm.

4 RESULTS

An example image of the experiment dataset undergoing all steps of the methodology developed can be seen in Figures 2-9.

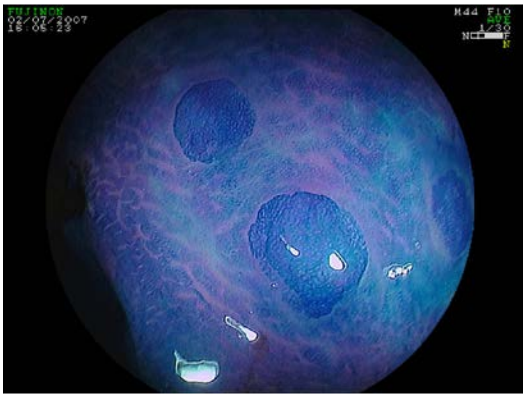

Figure 2 – Original image.

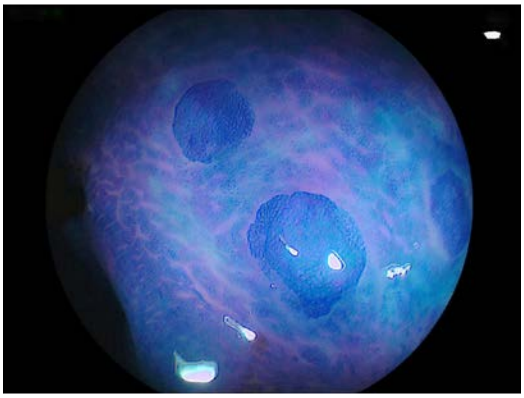

Figure 3 – After a median filter.

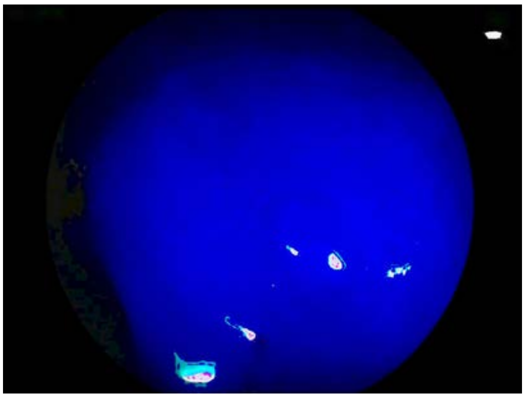

Figure 4 – Resultant color map.

Figure 5 – Detect glare pixels.

Figure 6 – Contours detected.

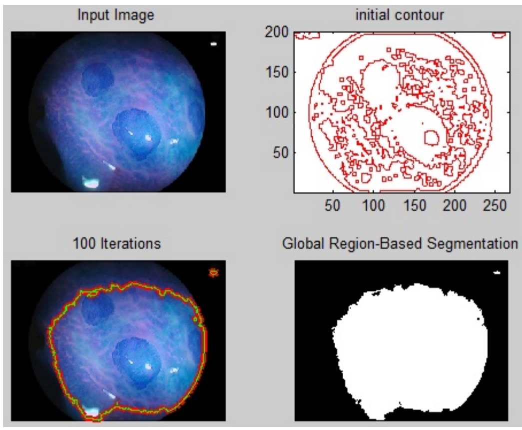

Figure 7 – Segmentation resultant of a level set algorithm.

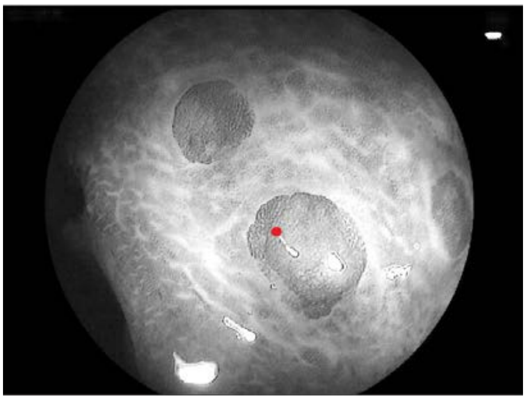

Figure 8 – Automatically detection of the seed to be used in the new region growing algorithm.

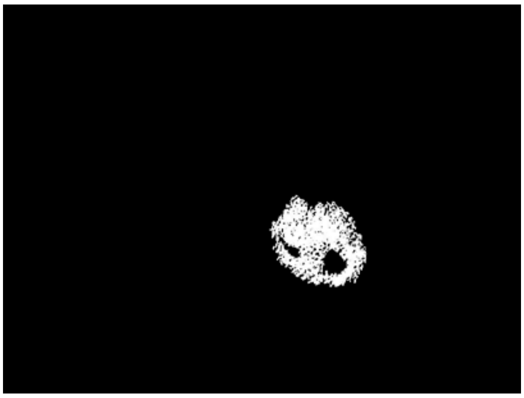

Figure 9 – Segmentation resultant of the automated region growing algorithm.

It should be noted that, although the original image has at least two aberrant crypt foci, the methodology developed was only optimized for the detection of one ACF.

5 CONCLUSIONS

It is of great value and interest the automatic segmentation of the aberrant crypt foci in endoscopy images, once it is a precursor of the colorectal cancer.

The usual image acquisition conditions difficult the image preprocessing and consequently the posterior segmentation. We have been developed a new methodology for the automatically detection of ACFs in endoscopy images. The experimental results obtained have been promising, but improvements are needed to detect more than one ACF and to better overcome some noise and artifacts of the usual original images.

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