SMART VISION CHIP FOR COLON EXPLORATION

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Abstract. Colorectal Cancer (CRC) is the second-highest cause of death by cancer worldwide with 880,792 deaths in 2018 and a mortality rate of 47.6%. 95% of CRC cases begin with the presence of growth on the inner lining of the colon or the rectum, called a polyp. Multiple types of polyps exist; among them, adenoma polyps, which can degenerate into CRC. CRC is treatable in 90% of the cases if it is detected early enough. This is a real public health problem where it is necessary to implement early detection policies to reduce the mortality rate of this cancer.

The endoscopic capsule was invented by Paul Swain in 1990. It is a pill incorporating a camera and a radio communication system that the patient swallows and transmit images from the gastrointestinal tract through the body in a workstation. Once all images are transmitted, a gastroenterologist downloads them to perform a visual analysis and detect abnormalities and tumors. Using this device doctors can detect polyps, at least 5 mm, with sensitivity and specificity respectively of 68.8% and 81.3%. This endoscopic capsule presents some limitations and weaknesses related to the spatial and temporal resolution of images, its energy autonomy and the number of images transmitted to be analyzed by the gastroenterologist.

In this demonstration, we propose an embedded system containing a processing chain capable of detecting polyps. This chain will be integrated into an endoscopic capsule. It is constituted by five parts: region extraction using Hough Transform, region follow-up, region's feature extraction, region classification, and region aggregation. This demonstration works in real-time, 25 images per second in an FPGA based system.

We use a Zynq board and implement the Hough Transform part in the reconfigurable fabric. The other parts are implemented in the CortexA9. We consider images of 1920x1080 pixels.

Keywords: Automatic polyp detection, intelligent endoscopic capsule, Hoguh transform, fuzzy trees, fuzzy forest, artificial vision and hardware accelerator.