Empirical Comparison of Visual Descriptors for Multiple Bleeding Spots Recognition in Wireless Capsule Endoscopy Video

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Abstract. Wireless Capsule Endoscopy (WCE) is the latest technology able to screen intestinal anomalies at early stage. Although its convenience to the patient and its effectiveness to show small intestinal details, the physician diagnosis remains not straight forward and time consuming. Thus, a computer aid diagnosis would be helpful. In this paper, we focus on The Multiple Bleeding Spots (MBS) anomaly. We propose to conduct an empirical evaluation of four feature descriptors in a the challenging problem of MBS recognition on WCE video using the SVM classifier. The performance of the four descriptors is based on the assessment of the performance of the output of the SVM classifier.

Keywords: Wireless Capsule Endoscopy, Feature descriptors, SVM, Multiple Bleeding Spots.

1 Introduction

Gastro diseases is now a significant threat to millions of people. Many Gastro diseases can be treated by early detection. The conventional methods of diagnosis like CT scan, endoscopy and X-ray, have different defects such as inconvenience for patients, and invasiveness. During the last decade, wireless capsule endoscopy (WCE) has been widely used to diagnosis gastrointestinal diseases. WCE is convenient, allow seeing the small intestine without sedation, pain or air insufflations [1]. Moreover, this technique helps physicians to find the source of the unknown intestinal bleeding. The size of the capsule endoscopy is 26 mm x11 mm and it includes a micro camera, battery, source of light and a radio transmitter [1]. The patient ingests the WCE after fast for about 8 to 24 hours with a small amount of water [1]. Then, the capsule starts to capture the images during moving forward over the gastrointestinal tract. Simultaneously, the captured video is wirelessly emitted to a receiver attached to the patient. The whole process lasts up to eight hours. Thereafter, the captured video is downloaded to the computer, and the physician examines it and analyzes the state of gastrointestinal tract. WCE generates about 60,000 images per patient. It takes about two hours for an experienced physician to analyze the video [1]. This disadvantage reduce the

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promotion of this newly appearing technique. As a result, WCE video analysis becomes an active filed of research. Recently, several studies have been achieved to enhance the display quality [2], identify suspicious images showing certain anomaly symptoms [3,4,5], and isolate useless frames [6,7]. Some efforts to detect red bleeding region (figure 1(b)) and ulcer region (figure 1(d)) using WCE images have been made. P. Khun et al [8] explored the performance of color and texture features in red bleeding detection. B. Li et al. [9] proposed a new method using multi-scale texture features to distinguish between red bleeding, ulcer and tumor diseases of the GI tract. In order to detect ulcer anomaly, L. Yu et al. [10] proposed an approach based on bag-of-words model and feature fusion technique. Y. Lee et al. [11] developed a method that detects bleeding spots images by using statistical features.

To the best of our knowledge there is no research or studies addressing multiple bleeding spots. Multiple bleeding spots appear in WCE as a set of small light points as shown in (figure 1 (a)). Due to the visual characteristics of these abnormally and it's similarity to the intestinal bubbles (figure 1 (e)), the recognition of the multiple bleeding spots is challenging. Moreover, the multiple bleeding spots are different from the intestinal bleeding (figure 1 (b)) which is characterized by its red color. Besides, the red bleeding has different shape and texture from the MBS anomaly. Thus, feature descriptors that are proved to recognize red bleeding may not be effective to recognize MBS.

In this paper, we propose to conduct a study that aims to find a suitable feature descriptor that can efficiently discriminate between normal WCE frames and those containing MBS anomaly. Namely, we will compare the HSV Color moment [12], the 2D wavelet descriptors [13], the Gabor filter descriptor[14], and the Edge histogram [15]. The comparison is based on the assessment of the performance of the SVM classifier [16].

2 Feature Extraction

Feature descriptors play a key role in pattern recognition. In fact, they allow a mapping from visual information (e.g the physical image) to a numerical vector in such away that it reflects the semantic content of the images (color, texture, shape etc..). Several Feature descriptors have been cited in the literature [17]. Some of them are generic, such MPEG 7 feature descriptors [15], and can be used with any data. Others are designed for a specific application. In all cases, the feature descriptor is supposed to capture the visual characteristics of the pattern to recognize. In [18], the authors presented an empirical measurement of the potential of some visual MPEG-7 descriptors for blood and ulcers detection on WCE video. Their experiments showed that the best results are obtained by the Scalable Color [15] and Homogenous Texture descriptors [15]. The paper [19] addresses the problem of tumor recognition for WCE images by using color texture feature and wavelet.

In the considered problem of MBS detection, the anomaly appears as a set of small light circles in the video frame. This is the rational behind the use of a color feature (e.g the HSV color histogram [12]), a texture feature able to