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A NOVEL APPROACH FOR ULCER DETECTION IN WCE IMAGES

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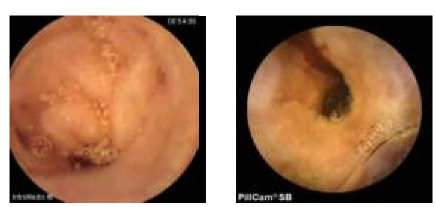
***Abstract*—Ulcer is one of the most common symptoms of many serious diseases in the gastrointestinal tract which may lead to malignant stages too. Especially for the ulcers in the small bowel where other procedures cannot adequately visualize, wireless capsule endoscopy (WCE) is increasingly being used in the diagnosis and clinical management. The application of image enhancement technology in Wireless capsule Endoscopy (WCE) could extremely boost its diagnostic yield. The quality of acquired images during endoscopy degraded due to factors such as environmental darkness and noise. Abnormalities in the GI tract may be present in only one or two frames of the video, so they might be missed by physicians due to oversight sometimes. Moreover, there may be some abnormalities that cannot be detected by the naked eyes because of their size, color, texture and distribution. Image enhancement is applied to enhance small details, texture and contrast of the images. Gaussian Kernel methods used to filter the image to remove the noise; canny edge detection and segmentation are used to detect the edge pixels. The proposed methods assist the clinicians to diagnose the bleeding, ulcer and tumor images based on image enhancement techniques. The experimental results revealed that the proposed scheme is promising in Ulcer detection.**

***Keywords* - Superpixel, Gaussian Filter, Edge Detection, Wireless Capsule endoscopy**

I. Introduction

A human digestive system consists of a series of several different organs including the esophagus, stomach, small intestinal (i.e., duodenum, jejunum, and ileum) and colon. Standard endoscopy has been playing a very important role as a diagnostic tool for the digestive tract. For example, various endoscopies such as gastroscopy, push enteroscopy, colonoscopy have been used for the visualization of digestive system. However, all methods mentioned above are limited in viewing small intestine. To address the problem, Wireless Capsule Endoscopy (WCE) was first proposed in 2000, which integrates wireless transmission with image and video technology. WCE generates large amount of images from the whole process of inspection. Computer-aided detection of ulcer is considered an indispensable relief to clinicians. Wireless capsule endoscopy (WCE) [1]needs computerized method to reduce the review time for its large number of images. In this case, the analysis for large number of endoscopy images which is given as input some time it leads to inexplicable report and thresholding methods are unreliable. The wireless capsule endoscopy (WCE), uses an imaging capsule[5] to view the whole gastrointestinal (GI) tract and it can examine the entire small intestine without pain, sedation, or air insufflation, which are inevitable in traditional endoscopy examination. The enhanced images[2] were classified using CAD model.[4]



(a) (b)

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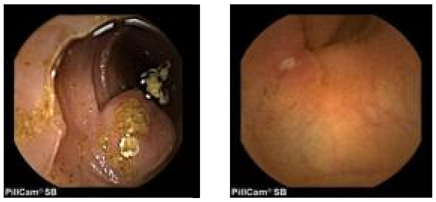

(c) (d)

Fig. 1.WCE samples
(a) Normal Image (b) Bleeding Image (c) Tumor Image (d) Ulcer Image

II. Related Work

Image segmentation [3] is the process of obtaining particular regions from the images. Edge detection identifies the edge points around the needed objects. Contour extraction refers to outlining the segmented portion from the image. In order to make the method practically useful in hospital clinical trials, further tests using a much larger number of datasets are critical to validate the effectiveness and the robustness of the WCE images. Furthermore, this study is proposed to implement efficient ulcer recognition task for the WCE images [7] such as bleeding [6], ulcer [8] and tumor detection using different dataset.

III. Techniques Used

Image segmentation is the process of dividing an image into multiple parts that is used to identify relevant information in digital images. In the proposed work, the Gaussian kernel methods used to reduce noise; canny edge detection algorithm is used to produce thick continuous edges with reliable values. The proposed method mainly consists of three steps: (A) Gaussian kernel (B) Edge detection (C) Super pixel segmentation.

A. Gaussian Kernel

Gaussian filtering is done by convolving each point in the input array with a Gaussian kernel and then summing them all to produce the output array. Invert filter alters the original value of color pixel to its inverse value. It inverts each pixel value to its inverted value. Smoothing, also called blurring. It is a simple and frequently used image processing operation. Here smoothing is used in order to reduce noise. A grayscale image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort, also known as black-and-white, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest.

B. Edge Detection

Edge detection in image processing is a tool which detects areas in images with sudden change in brightness. Used to reduce the amount of data in an image and preserve high threshold pixel for further processing. Canny edge detection algorithm aims to satisfy three main criteria:

Low Error Rate: Meaning a good detection of only existent edges.
Good Localization**:** The distance between edge pixels detected and real edge pixels have to be minimized.
Minimal Response: Only one detector response per edge.

Steps:

1) Filter out any noise. The Gaussian filter is used for this purpose. An example of a Gaussian kernel of size=5 that might be used is shown below:

$$K = \frac{1}{159}\begin{bmatrix} 2 & 4 & 5 & 4 & 2 \\ 4 & 9 & 12 & 9 & 4 \\ 5 & 12 & 15 & 12 & 5 \\ 4 & 9 & 12 & 9 & 4 \\ 2 & 4 & 5 & 4 & 2 \end{bmatrix}$$

2) Find the intensity gradient of the image. For this, we follow a procedure analogous to Sobel. Apply a pair of convolution masks in x and y directions.

$$G_x = \begin{bmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{bmatrix}$$

$$G_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ +1 & +2 & +1 \end{bmatrix}$$

Find the gradient strength and direction with: The direction is rounded to one of four possible angles (namely 0, 45, 90 or 135

$$G = \sqrt{G_x^2 + G_y^2}$$

$$\theta = \arctan\left(\frac{G_y}{G_x}\right)$$

3) *Non-maximum suppression:* This removes pixels that are not considered to be part of an edge. Hence, only thin lines (candidate edges) will remain.

4) Hysteresis: The final step Canny uses two thresholds (upper and lower). If a pixel gradient is higher than the *upper* threshold, the pixel is accepted as an edge. If a pixel gradient value is below the *lower* threshold, then it is rejected. If the pixel gradient is between the two thresholds, then it will

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be accepted only if it is connected to a pixel that is above the *upper* threshold.

C. Monochrome Segmentation

Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). Image segmentation is defined as a partition of pixels or image blocks into homogeneous groups. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images .In Monochrome segmentation, each pixel is stored as a single bit 0 or1.

Fig.2 Inverted Image

Fig.3 Mean Removal

Fig.4 Smoothing process

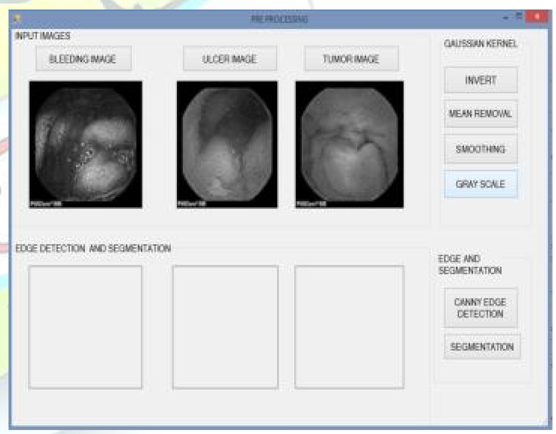

Fig.5 Gray scale Image

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Fig.6 Canny Edge Detection without filtering

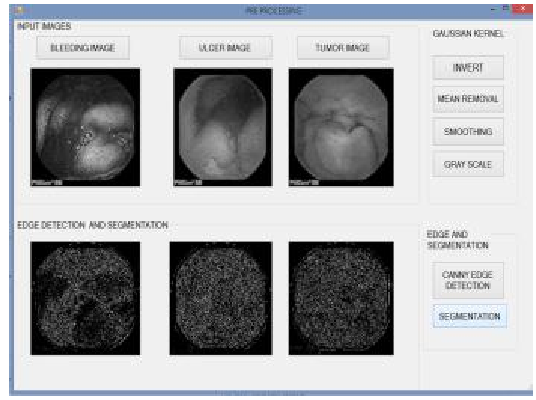

Fig.9 Monochrome Segmentation after filtering process

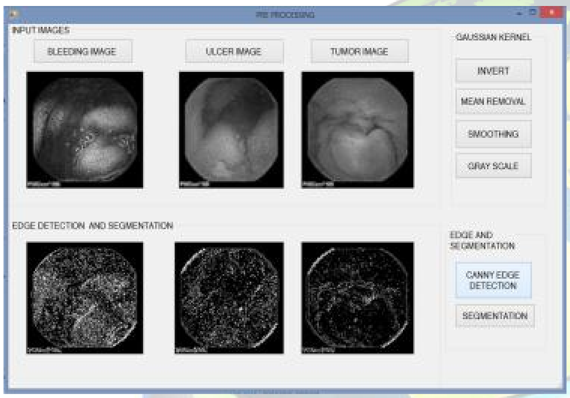

Fig.7 Canny edge detection after filtering process

Fig.8 Monochrome Segmentation

In this work, the image containing bleeding region was labelled as a 1 set of sample, non bleeding (ulcer) as 2nd set of sample and tumour as 3rd set of sample. Without the filtering process the images are not so clear. Invert filter alters the original value of color pixel to its inverse value and the mean removal process is able to remove the outliers without reducing the sharpness of the image. Then Smoothing is applied to reduce noise and to prepare the images for further processing such as segmentation. Gray scale is used to convert color images to shades of gray. Canny edge detection highlights the edge pixels so that affected regions are identified effectively. The experimental results show that the proposed method is promising in image enhancement and assist physicians to diagnose the lesions.

IV. Conclusions

In the proposed work a set of labelled WCE images consisting of bleeding frames, non bleeding frames and Tumor frames is tested for evaluation. Gaussian Kernel methods such as Invert, Mean removal, smoothing, Gray scale along with Canny Edge detection algorithm provides a robust solution because it identifies and locates sharp discontinuities in images. So clearer edges are visible and are ease for the physicians to assist the diagnosis of bleeding, ulcer and tumor lesions from the WCE images.

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