

DETECTION AND ESTIMATION OF SMALL INTESTINAL ULCER USING WIRELESS CAPSULE ENDOSCOPY

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ABSTRACT

A new method for rapid bleeding detection in the WCE (Wireless capsule endoscopy) video is proposed. The standard WCE (Wireless capsule endoscopy) capsules takes direct images from patient. No standard for capsule endoscopy image interpretation and classification. The group pixels through superpixel segmentation to reduce the computational complexity. Feature of each superpixel is extracted using the red ratio in RGB space and fed into support vector machine for classification.

Also, the influence of edge pixels has been removed that our algorithm is superior to the existing methods in terms of sensitivity, specificity, and accuracy.

Also our proposed system invokes Pearson's correlation coefficient to segment to the lesion area and for decision making.

Keyword - WCE, Superpixel Segmentation, Pearson correlation coefficient.

1. INTRODUCTION

Endoscopy was first introduced in 1853 by Antoine Jean Desormeaux. The invention earned him the title of "father of endoscopy". The first fibre optic endoscope was made possible by Basil Hirschowitz from the University of Alabama in 1954.

Endoscopy is used as a diagnostic and therapeutic tool for various indications, ranging from gastrointestinal exploration to knee surgery. A few years ago, the assessment of small bowel pathology was a major dilemma, especially when it came to the management of obscure gastrointestinal bleeding. Evaluation of the patients was frequently unsatisfactory because of the inability to completely visualize the small bowel mucosa with the available endoscopic and radiological techniques. Capsule endoscopy (CE) was launched at the beginning of this millennium and since then has had a very important impact on managing obscure gastrointestinal bleeding and many other small bowel diseases.

Currently, endoscopy is used as a diagnostic and therapeutic tool for various indications, ranging from gastrointestinal exploration to knee surgery.

Capsule endoscopy (CE) is a simple, safe, non-invasive, reliable technique, well accepted and tolerated by the patients, which allows complete exploration of the small intestine. The advent of CE in 2000 has dramatically changed the diagnosis and management of many diseases of the small intestine, such as obscure gastrointestinal bleeding, Crohn's disease, small bowel tumors, etc.

Pearson's Correlation coefficient is defined as often several quantitative variables are measured on each member of a sample. If we consider a pair of such variables, it is frequently of interest to establish if there is a relationship

between the two; i.e. to see if they are correlated. We can categorize the type of correlation by considering as one variable increases what happens to the other variable.

1.1 Medical Image Processing

Medical image processing deals with the development of problem-specific approaches to the enhancement of raw medical image data for the purposes of selective visualization as well as further analysis. There are many topics in medical image processing: some emphasize general applicable theory and some focus on specific applications. We mostly focus on image segmentation and multi-spectral analysis.

There are a number of specific challenges in medical image processing:

1. Image enhancement and restoration
2. Automated and accurate segmentation of features of interest
3. Automated and accurate registration and fusion of multimodality images
4. Classification of image features, namely characterization and typing of structures
5. Quantitative measurement of image features and an interpretation of the measurements
6. Development of integrated systems for the clinical sector Design, implementation, and validation of complex medical systems require not only medical expertise but also a strong collaboration between physicians and biologists on the one hand, and engineers, physicists, and computer scientists on the other.

Noise, artifacts and weak contrast are the principal causes of poor image quality and make the interpretation of medical images very difficult. They are responsible for the limited success of conventional or traditional detection and analysis algorithms. Poor image quality invariably leads to problematic and unreliable feature extraction, analysis and recognition in many medical applications.

1.2 Methodology

The existing methods can be roughly classified into image based methods and pixel based methods. Image based methods proposed to detect bleeding regions using 54 statistical features (e.g., standard deviation, variance, and skew) . It is calculated from a colour histogram of six colour components such as R, G, B, H, S, and V. It is the intensity value of each block centre. Finally, all intensity values are combined to form a feature vector for classification.

Pixel based methods calculated from fair amount of pixel based detection methods have been proposed. It detect bleeding pixels by using probabilistic neural network (PNN). It distinguished the bleeding and non-bleeding pixels by thresholding in RGB and HSV colour spaces, The R, G, and B colour features are used to produce the maximum likelihood estimates.

2. ULCER DETECTION

We propose a new method that can detect bleeding regions from WCE video more effectively and efficiently. We first detect the edge pixels, and then use the morphological dilation to locate and remove the edge regions. Instead of processing each pixel or dividing the image uniformly.

The group of pixels adaptively based on color and location through superpixel segmentation. Then each image can be represented by hundreds of superpixels and the computational complexity is also reasonable. For each superpixel, the feature is defined using the red ratio in RGB color space.

Finally, Pearson's correlation coefficient is used to classify the bleeding and non-bleeding superpixels / Lesion area.

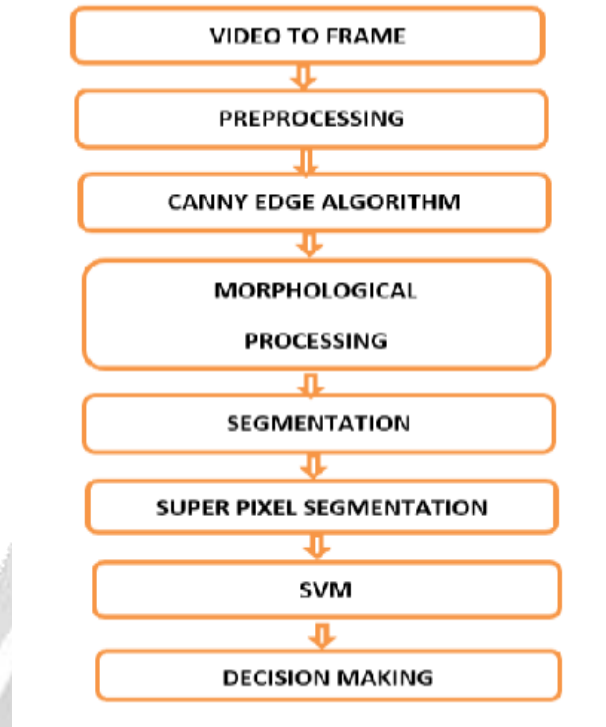


Fig-1: Basic steps involved in detection of intestinal bleeding

2.1 Canny Edge Detection

In this process the image is being made to pass through an gaussian filter in order to remove the noise from the obtained image. The main aim of this filter is:

- It optimizes the trade-off between noise filtering and edge localization

The various steps involved here are:

- 1)Smoothing the image with a Gaussian
- 2)Compute the Gradient magnitude using approximations of partial derivatives using a 2x2 filters
- 3) Thin edges by applying non-maxima suppression to the gradient magnitude
- 4)Detect edges by double thresholding

2.2 Superpixel Segmentation

With the development of imaging technology, the resolution of sensor becomes higher and higher. The new generation WCE, PillCam SB2, captures nearly twice the mucosal area per image compared to PillCam SB, which makes the pixel by pixel methods more time consuming than before. To reduce the computational cost and make bleeding detection faster, we propose to group the pixels based on color and location first, and then detect bleeding at superpixel level.

Pearson correlation coefficient is a statistical measure of the strength of a linear relationship between paired data.

Furthermore details about correlation range and its types

- Positive values denote positive linear correlation;
- Negative values denote negative linear correlation;
- A value of 0 denotes no linear correlation;
- The closer the value is to 1 or -1, the stronger the linear correlation.

Correlation is an effect size and so we can verbally describe the strength of the correlation using the guide that Evans (1996) suggests for the absolute value of r.

3. RESULT

The following section accounts on the output of the detection of the ulcer and the extent to which the patient is being affected.

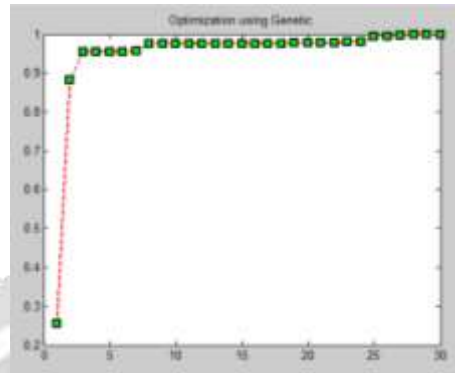


Chart -1: Graphical representation of the extent to which the Detection process is being done

The above chart accounts on the graphical representation which helps in accounting on the extent to which the person is being affected.

3.1 Optimised Results

The final step involved is the detection process. Here with the help of special techniques like SVM, PSO, DPSO and GENETICS the image is being detected.

Super pixels aim to resolve this by representing the image in a more logical manner, grouping pixels based on homogeneity criteria and restoring the object boundaries.

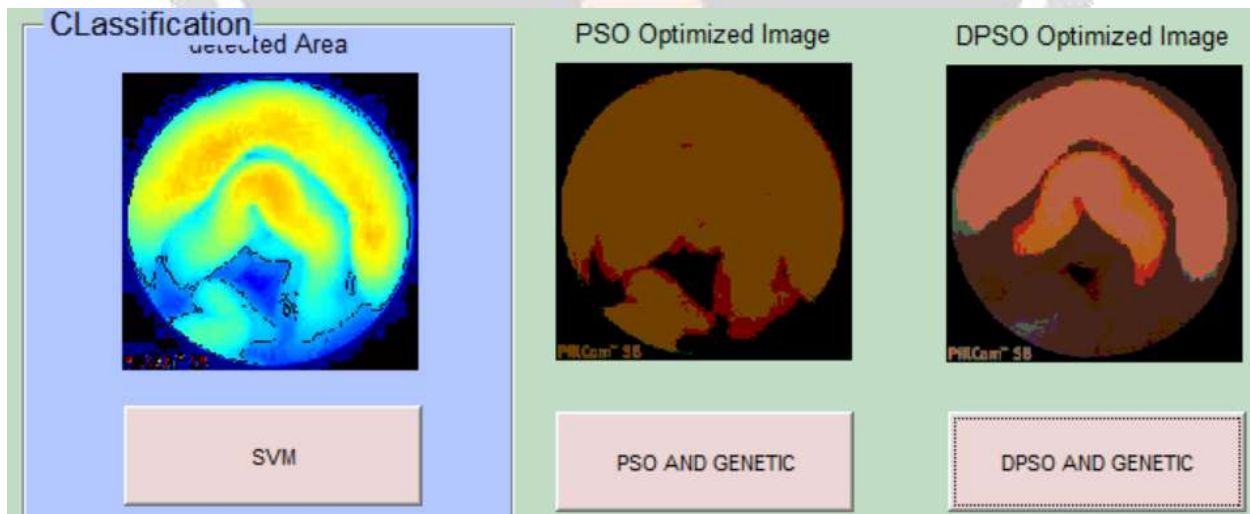


Fig -2:The resultant image obtained from WCE

This provides a differing representation of each image, where the boundaries are irregular and the superpixels are of different size. This is achieved by image over segmentation, the process of reducing an image into a number of regions, by covering images in such a way as to create non-overlapping regions of homogeneous colour. A superpixel can be defined as a spatially coherent homogeneous structure.

4. CONCLUSIONS

Thus the given system over the existing system has some advantages and some of them are

- Low cost when compared to existing system
- High throughput than the existing system
- Automated system that eliminates manual process
- Eliminate number of man power required
- Time of processing is less than the existing system

These are some elements on which the given system varies and improvised over the existing system called colonoscopy. The process involved with this wireless capsule endoscopy is explained in a detailed manner in the above chapters with required diagrams and explanations.

All the input and output images given and obtained are inserted above with a reference diagram of the capsule images that are captured for the image processing.

Further enhancements on this system can be done in many ways by improving the processing time and detection can be more automated by enclosing every process into a single process where results can be generated furthermore accurately.

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