Implementation of Computer Aided Cancer Cell Detection Using Capsule Endoscopy Image

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Abstract— Together with various cancers, the colon cancers grow into a leading problem to human. There are many screening methods are used to find cancer cells in colon region. Such methods are sigmoidoscopy, colonoscopy, stool DNA test, etc. In this paper, the endoscopy images are used to examine the colon region whether the cancer cells are present or not. Capsule endoscopy is a recent procedure to capture the images of colon region. These images are segmented using the Aphelion Dev software. Here the threshold segmentation is to be done to get the cancer cell and normal cell images distinctly.

Key words: Capsule Endoscopy; Cancer Images; Segmentation Technique

I. INTRODUCTION

Capsule endoscopy is a technique to inspect the small bowel mucosal lesion which cannot be seen using other imaging methods the capsule endoscopy is a pill in the structure which has a camera in one end. The images captured by the capsule endoscope are used to detect the normal and tumor cell images. It captures up to 50,000 images i.e. 2 frames per second. This process takes 8 hours to complete and the pill comes out within 2 days. The captured images are stored and recovered by the recorder unit. The segmentation is the process of dividing the images into multiple parts. The threshold segmentation technique is used here. Based on the threshold range the images are classified into normal and abnormal cell images and cancer cell images. Aphelion Dev is imaging software which is used to segment the capsule endoscopy images to get a better result as compared with the existing technique.

Alexandros Karargyris et al (2015), proposed a method to get accurate localization of small-bowel lesions and endoscopic video stabilization in wireless capsule endoscopy. Odo Capsule can stabilize itself inside the small-bowel lumen and they give smoother video capture and good quality image processing.

Baopu Li et al (2012) proposed a novel method to remove impurities frames in WCE videos. In the first stage, frames of gastric juice are eliminated by using local HS histogram features. In the second stage, a new approach is carried out to remove the bubbles frames in the WCE video, which combines Color Local Binary Patterns (CLBP) algorithm with Discrete Cosine Transform (DCT). K-Nearest Neighbor (KNN) classifier is used in both stages for its rapidity. Experiments demonstrate that the proposed scheme is an effective approach for removing noninformative frames in WCE video and the accuracies of each stage can reach as high as 99.31% and 97.54% respectively.

Bulumulla, S et al, (2015), described a method to divide the WCE image into sub-images and rejects all sub-images in which tissue is not clearly visible. We then create a feature vector combining color and texture information of the entire image and valid sub-images. Color features are derived from Hue Saturation histograms, compressed using a hybrid transform, incorporating the Discrete Cosine Transform (DCT) and Principal Component Analysis (PCA). A second feature combining color and texture information is derived using Local Binary Patterns. The video is segmented into meaningful parts using Support Vector Classifier built within the framework of a Hidden Markov Model (HMM).

Christian Di Natali et al (2013), proposed an average error below 5 mm in position detection, and below 19 for angular motion within a spherical workspace of 15 cm in radius. Gastrointestinal endoscopy has the ability to make screening less invasive and more acceptable, thus saving lives by early diagnoses and treatment. Closed-loop control of the magnetic device position is very crucial for reliable and safe operation.

Elif Aybar et al (2006) presented a paper on Sobel which is a popular edge detection method is considered in this work. There exists a function; The edge is in the image toolbox. The Sobel method uses the derivative approximation method to find edges in edge detection. Therefore, the edges turn and the gradient of the considered image is maximum. The horizontal gradient and the vertical gradient matrices have the dimensions 3×3 for this method. In this work, a function is developed to find edges using the matrices whose dimensions are 5×5 in Matlab.

Jianwu Dong et al (2015), proposed a Quantitative susceptibility mapping (QSM) is a magnetic resonance imaging technique that reveals tissue magnetic susceptibility They possess having a high-quality field map, typically acquired with a relatively long echo spacing and long final TE. QSM is used to remove the fat contributions in the brain to the total signal phase. This technique is referred as phase unwrapping and removal of chemical shift (SPURS). The SPURS is used as the initial guess for a voxel-wise iterative decomposition of water and fat with echo asymmetric.

P. Vieira et al. (2012) proposed a Maximum Likelihood (ML) based approach to deal with this situation. The results show that tumor segmentation becomes more effective in the HSV than in the RGB color space where diagonal covariance matrices have similar effectiveness than full covariance matrices. State of the art algorithms for diagnosis of the small bowel by using capsule endoscopic images usually rely on the processing of the whole frame, hence no segmentation is usually required. The context information is not only the way to improve robustness. Alternatives could come from a more effective use of the color information.

Qian zhao et al (2010) proposed a novel scheme to catalog the WCE video clips with respect to abnormalities instead of organs. The aim of the proposed scheme is to provide an alternative option to doctors in hope to increase the accuracy of the diagnosis as well as reduce the inspection time. The novel method is based on the adaptive non-parametric key-point detection using multi-feature extraction and fusion. Actual clinical patient videos including both normal and abnormal findings are used to evaluate the performance of the proposed method. The experimental results demonstrate that the proposed approach leads to efficient segmentation for WCE video clips without losing critical information of the original video record.

Ran zhou et al (2013) described new features and an improved classifier to improve the segmentation algorithm. In the rough level, the color feature is required to draw a dissimilar curves and an approximate boundary is obtained. Simultaneously, training data for the fine level can be directly labeled and collected between the two approximate boundaries of organs to overcome the difficulty of training data acquisition. In the fine level, a novel color Uniform local binary pattern (CULBP) algorithm is proposed, which includes two kinds of patterns, color norm patterns, and color angle patterns.

Ravindra S et al (2011) presented an algorithm for interactive segmentation of endoscopic dimensional images. The small number of user-labeled pixels is given and the rest of the image is segmented automatically by a Grow cut method. The segmentation is difficult to compute in another project. In the areas, where the segmentation is reliably computed automatically no additional user effort is required. Results of segmenting endoscopic images are presented.

SehyukYim et al (2014), proposed a new wireless biopsy method where a magnetically actuated untethered soft capsule endoscope carries and releases a large number of thermo-sensitive, untethered micro grippers (μ-grippers). The working principles and analytical models for the μ-gripper release and retrieval mechanisms, and evaluate the proposed biopsy method. The advanced navigation skills of centimeter-scaled untethered magnetic capsule endoscopes with highly parallel, autonomous, sub-millimeter scale tissue sampling μ-grippers offer a multifunctional strategy for gastrointestinal capsule biopsy.

Xiaofan Zhang et al (2015), described an automatic analysis of histopathological images has been widely utilized leveraging computational image-processing methods and modern machine learning techniques. The computer-aided diagnosis (CAD) and content-based image-retrieval (CBIR) systems are developed for the diagnosis of disease detection. They are also used for the decision support in this area. Specifically, we present a supervised kernel hashing technique which leverages a small amount of supervised information in learning to compress a 10 thin space000- dimensional image feature vector with the informative signatures preserved.

Yen-Hsi R. Tsai (2010), presented he problem of detection and segmentation of colonic polyps in endoscopic images obtained by a capsule device. Several procedures based on the geometric and image intensity features of the input medical image, together with vibrational segmentation methods are proposed and analyzed. The most successful procedure, and which has proven to efficiently detect and single out the colonic polyps, relies on the curvature information of the images, which are interpreted as the graphs of functions need over the pixel domain. The procedure involves curvature based identification to the graph of the original input image, and then a variational segmentation relying on this curvature identification. The other procedures are “image intensity" based segmentation techniques, and lead to a good detection of the lumen and colonic mucosa.

II. METHODOLOGY

The flow diagram is shown below:

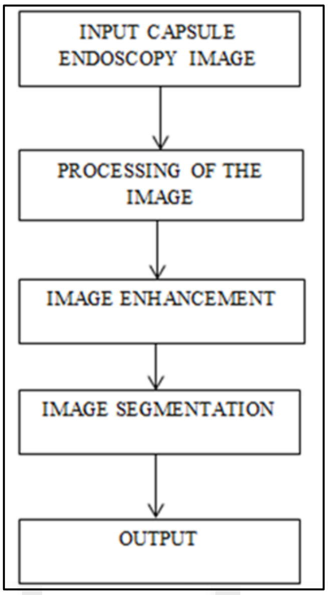

Fig. 1: Generalflowdiagram

A. *Description*

1) *Image Aquisition*

This is the process of capturing images through a device. Here capsule endoscope is used to capture the images of colon region. Capsule endoscopy is a small swallow able pill which has a camera inside it. This camera captures the images of the digestive tract. These images are transferred to the receiver which has a small recording device.

2) *Preprocessing Of The Image*

In this, the images are pre-processed before analyzing to increase the reliability. This may contain several filter operations which give accurate image details for easier or faster evaluation. In this paper, the Gaussian filtering technique is used to filter the image. As compared to other filter operations the Gaussian filter produces a better result.

3) *Image Enhancement*

Image enhancement is used to improve the perception of information. Image enhancement techniques can be classified into two. They are spatial domain method and Frequency- domain method. In this paper, the histogram equalization technique is used to enhance the image. In this method, the histogram values are plotted between the number of pixels in the vertical axis and brightness value in the horizontal axis. This can be improving the contrast and brightness of the image.

4) *Image Segmentation*

Image segmentation is the process of dividing an image into multiple parts. This is used to obtain clear information of digital images. There are many methods are there to perform segmentation. Some of the segmentation methods are thresholding method, color based segmentation, transform method and texture method, etc. In this paper, the thresholding is the common segmentation technique which is used to obtain a good result. In threshold segmentation technique each pixel in the images is considered as a black and red color. Based on the range of threshold values the images are segmented as normal and abnormal images.

III. RESULTS AND DISCUSSION

The input acquired gastrointestinal ulcer image as shown in Figure 2.1 (a) and the normal image is shown in Figure 2.1(b)

Fig. 2.1: (a). Input Normal Image

Fig. 2.1: (b) Input Ulcer Image

Input ulcer image is converted into the gray scale image as shown in Figure2.2 (a) and input normal image is converted into gray scale image as shown in Figure 2.2(b)

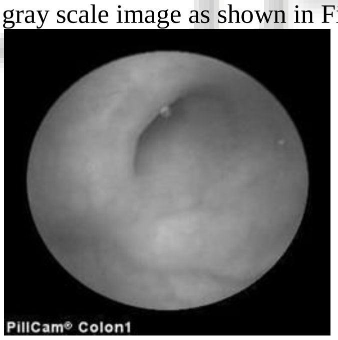

Fig. 2.2: (a) Gray scale normal Image

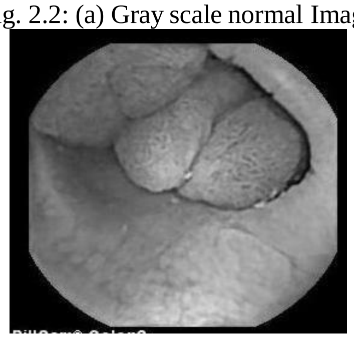

Fig. 2.2: (b) Grayslake Ulcer Image

Only the ulcer region is taken into account to find cancer and normal cells. So, the ulcer region from abnormal cell image and normal region from normal cell images are taken using the region of interest (ROI) shown in fig2.3 (a) and 2.3(b).

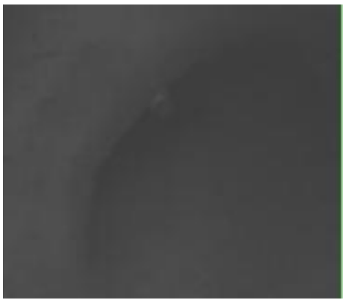

Fig. 2.3: (a) ROI normal Image

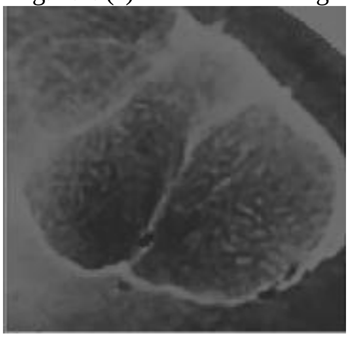

Fig. 2.3: (b) ROI of Ulcer Image

These regions are enhanced using the histogram equalization technique to improve the quality of the image as shown in fig .2.4(a) and 2.4(b). The histogram values for the enhanced images are shown in fig 2.5(a) and 2.5(b).

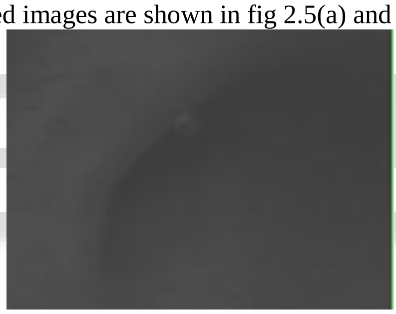

Fig. 2.4: (a). Enhanced Normal Image

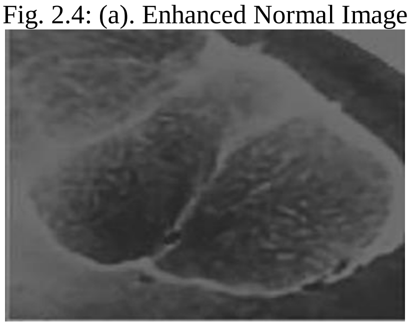

Fig. 2.4: (b) Enhanced Ulcer Image

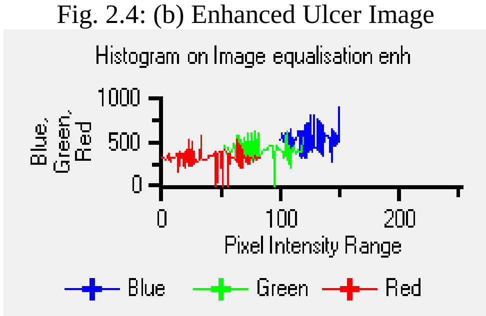

Fig. 2.5: (a) Comparison of RGB using Histogram equalization (Normal Image)

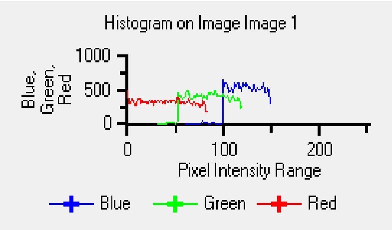

Fig. 2.5: (b) Comparison of RGB using Histogram equalization (Ulcer Image)

These enhanced images are again filtered to remove unwanted noises in the image. The Gaussian filter is the best filter to produce a prior outcome. The filtered normal image is shown in fig 2.6(a) and filtered abnormal image is shown in fig 2.6(b).

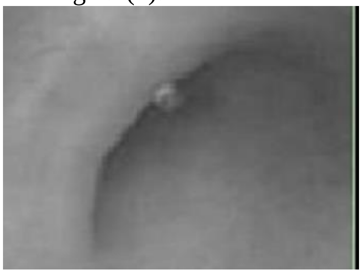

Fig. 2.6: (a) Gaussian filter (normal image)

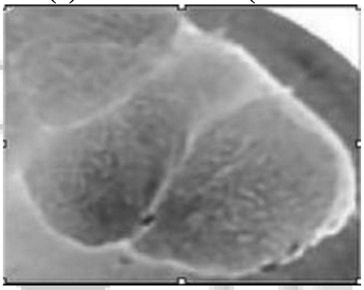

Fig. 2.6: (b) Gaussian filter (ulcer image)

The basic operation of this paper is segmentation. Here the threshold segmentation technique is used. The image pixels are considered into black and red color. This result shows the presence and absence of cancer in the capsule endoscope image. They are shown in fig 2.7(a) and 2.7(b).

Fig. 2.7: (a) Threshold Segmentation of normal image

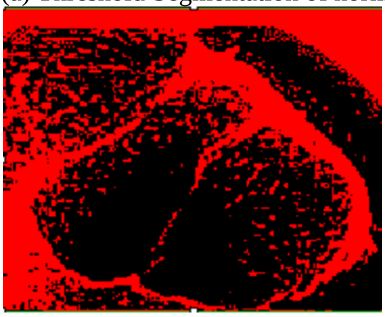

Fig. 2.7: (b) Threshold Segmentation of ulcer image

IV. CONCLUSION

In this paper, the cancer cell images of the colon region are identified using image segmentation technique. Here the images are enhanced and filtered to get a better result. These enhanced images are segmented to detect the normal and abnormal cell images separately. Aphelion Dev software suit is used to do these processes and this produces a good output as compared with other cancer cell detection techniques. This helps the physician to view the images clearly in a short time. In future work, WCE image is implemented in Unified Technology Learning Platform (UTLP) Kit.

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