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Parasite Detection Using Spatial Relationship Approach

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Abstract**: In this paper, human hookworm detection is based on spatial relationship between consecutive WCE image was proposed, aiming to reduce the number of image a clinician need to review. This method includes four stages they are preprocessing stage, tubular detection, feature extraction and classification stage. In preprocessing stage it includes noise reduction using guided filter and RGB to gray conversion. In second stage multi scale dual matched filter was used for tubular detection of hookworm and finally spatial classifier was proposed to classify wireless capsule endoscopy (WCE) images. The classification result will help to identify the presence of hookworm in WCE image. The accuracy value of the proposed method will be compared with existing method.

Keyword: Wireless Capsule Endoscopy, Hookworm detection, spatial classifier, tubular detection, matched filter.

I. INTRODUCTION

Hookworm infection is widely distributed in Asia and Africa but can also found in other tropical and subtropical zones. The most common hookworm species are Aneylostoma duodenale and Nectator americanous. Symptoms of hookworm infestation include stomach pain, loss of appetite, nausea, diarrhea, constipation, bloody stool , gas, itchy skin, fever and fatigue. These organisms can survive as long as 10 years in their hosts. Prolonged infections can lead to serious symptoms such as iron deficiency because of the blood they drink. The infection can also lead to heart problems.Respiratory symptoms such as a cough and wheeziness may develop when the larvae reach the lungs, a few weeks after exposure.

The wireless capsule endoscopy is a tool designed to allow for painless imaging of small intestine. It is equipped with a light source, camera, lens, radio transmitter and battery, that is propelled by the peristalsis along all gastro intestinal track, allowing full visualization of it from intestine without pain and sedation. WCE is considered as gold standard technique for diagnosis of intestinal bleeding, tumor, chronic abdominal pain etc. Automatic hookworm detection is a challenging task due to poor quality of images, presence of extraneous matters, complex structure of GI, and diverse appearances in color and texture. Fig. 1 shows several representative WCE images having hookworms.

Fig.1.Examples of WCE images having hookworms and complex structure of GI

II. PROPOSED SYSTEM

WCE images often suffer from noise and low visual quality because of complex Circumstances in GI tract and poor illumination conditions and there are many other contents in GI tract, such as food, stool, bile and bubbles, which influence the detection of parasitizes. To tackle the above mentioned challenges, in this paper a novel automatic hookworm detection approach is proposed for WCE images.

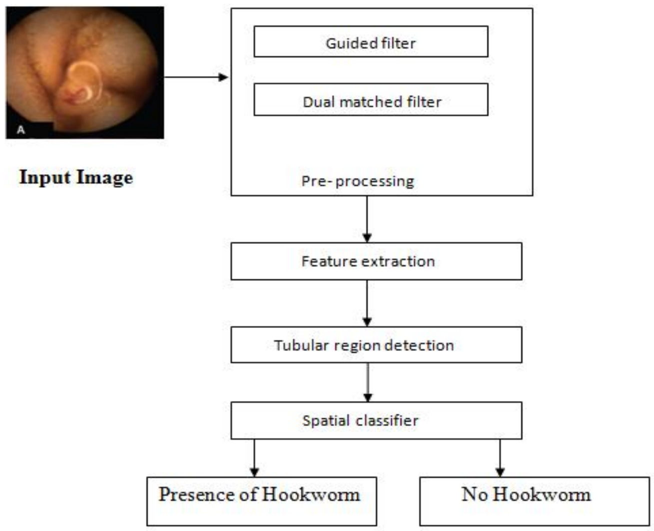

Fig 2. Block diagram of proposed system

The block diagram of the proposed system is shown in Fig 2. The input image is the WCE image. It is a gastrointestinal image which may contain hookworm, bubbles, small folds etc. The WCE images are usually dark and low contrast which may affect the performance of computer aided diagnosis system. In order to overcome this limitation guided filter is adopted for image enhancement. Then this WCE image is converted to gray image and then to binary image by changing the pixel values as “0” Black or “1” white.

A. Guided Filter Kernel

We first define a general linear translation- variant filtering process, which involves a guidance image I, an input image p, and output image q. Both I and p are given beforehand according to the application, and they can be identical. The filtering output at a pixel I is expressed as a weighted average

$$q_i = \sum_j w_{ij}(P) p_j$$

Where i and j are pixel indexes. The filter kernel w_{ij} is a function of the guidance image I and independent of p.This filter is linear with respect to p.

B.Multiscale Dual Matched Filter

The multiscale dual matched filter (MDMF) is used to detect the tubular region in WCE images. In order to adapt to different orientations, the kernel has to be rotated to all possible orientations, and a set of filter banks is obtained. The implementation of the filters is done by multiplying 0º filter with a rotation matrix, which is defined as follows,

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} cos\theta & sin\theta & tx \\ -sin\theta & cos\theta & ty \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

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Where (x, y) is a point in the 0º filter. The point (x', y′) is the rotated point around the pivot point (tx, ty) with degree θ. Here, the pivot point (tx, ty) is set to coordinate origin (0, 0). The filter bank is normalized to zero mean after rotation

Let f(x,y) be the image and m_t(x,y) be matched filter at scale σ_i. The response at σ_i is expressed as

R_i(x,y)= m_t (x,y) *f (x,y) Where * denotes the convolution operation.

C. Spatial Classifier

Spatial information plays a fundamental role in the analysis and understanding of remotely sensed data sets. Common ways of incorporating spatial information into classification involve the use of textural, morphological, and object-based features. When regions are represented as sets of points (pixels), spatial relationships can be modeled in terms of directional and distance information between pixel groups. In particular, adjacency of two regions can be measured as a fuzzy function of the distance between their closest points or using morphological dilations modeling connectivity's. Distance-based relationships can also be defined using fuzzy membership functions modeling symbolic classes such as near and far using the distance between boundary pixels.

III. EXPERIMENTAL RESULT

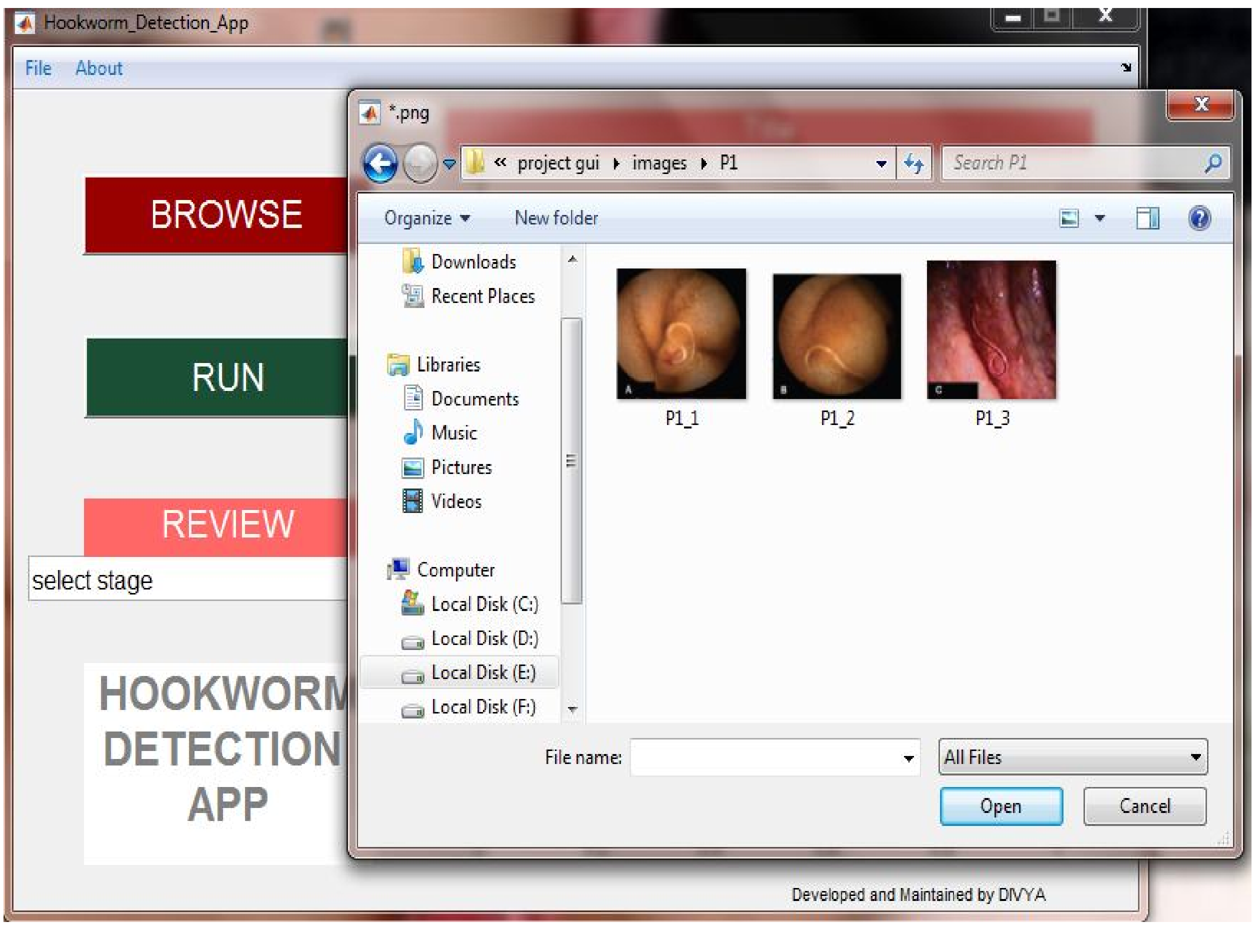

Fig 3 selection set of input images in dataset

Fig 3 shows the set of input images in dataset in which the image can be selected for preprocessing. The data set contains several wireless capsule endoscopy images of gastro intestine and one image is selected from the image dataset for further segmentation process. The data set window appears by clicking the browse control key.

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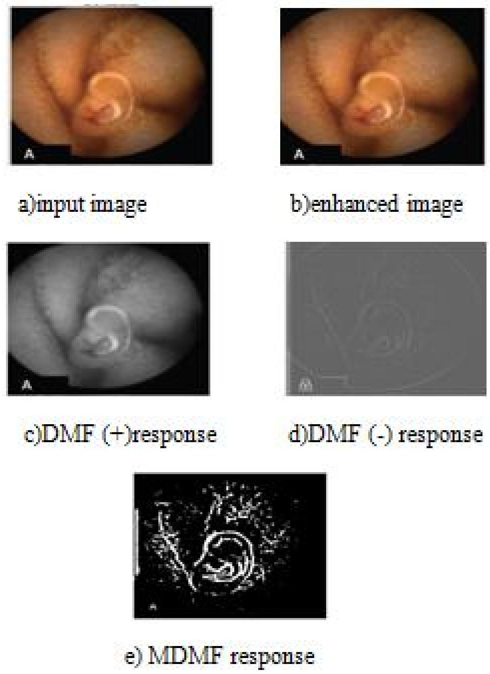

Fig 4 image enhancement and tubular region detection

A. Evaluation Criteri

To evaluate the performance of classification, Sensitivity (SE), Specificity (SP) and Accuracy (AC) are adopted as the performance metric, which are widely used in medical image classification tasks Ideally, we expect both sensitivity and specificity to be as high as possible. Since accuracy reflects sensitivity and specificity in relation to each other, it is also used to assess the overall performance of classification. High sensitivity means strong capability of detecting hookworm images. Due to the fact that an overwhelming majority of WCE images are non hookworm, the detected “hookworm” images have to be manually inspected by a doctor. Thus, the specificity should be high to minimize the workload of the doctor. Overall, sensitivity is more important than specificity and accuracy. They are defined as follows,

Accuracy = (TP + TN)/N

Sensitivity = TP/ (TP + FN)

Specificity = TN/ (TN + FP)

where TP is the number of correctly classified images containing hookworms. FN is the number of hookworm images that are falsely classified as non-hookworm images. FP is the number of non-hookworm images that are falsely classified as hookworms. TN is the number of non-hookworm images that are correctly labeled as non-hookworms, and N is the total number of images.

Table 1 Average Performance measurement for dataset

	ACCURACY	SENSITIVITY	SPECIFICITY
EXISTING METHOD	78.2000	77.2000	77.9000
PROPOSED METHOD	89.1200	90.6600	90.8400

IV. CONCLUSION

Computer aided detection of hookworm using WCE images is a challenging task. Different methods have been used to detect the hookworm. Although good performance was achieved 23% of hookworm images were not correctly detected. For the further improvement in this paper we have used spatial relationship based classification approach to boost the overall performance of the

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system. The ultimate goal is that automatic detection system can be used in a real condition to assist endoscopists, and can even obtain more accurate judgment than experienced endoscopist.

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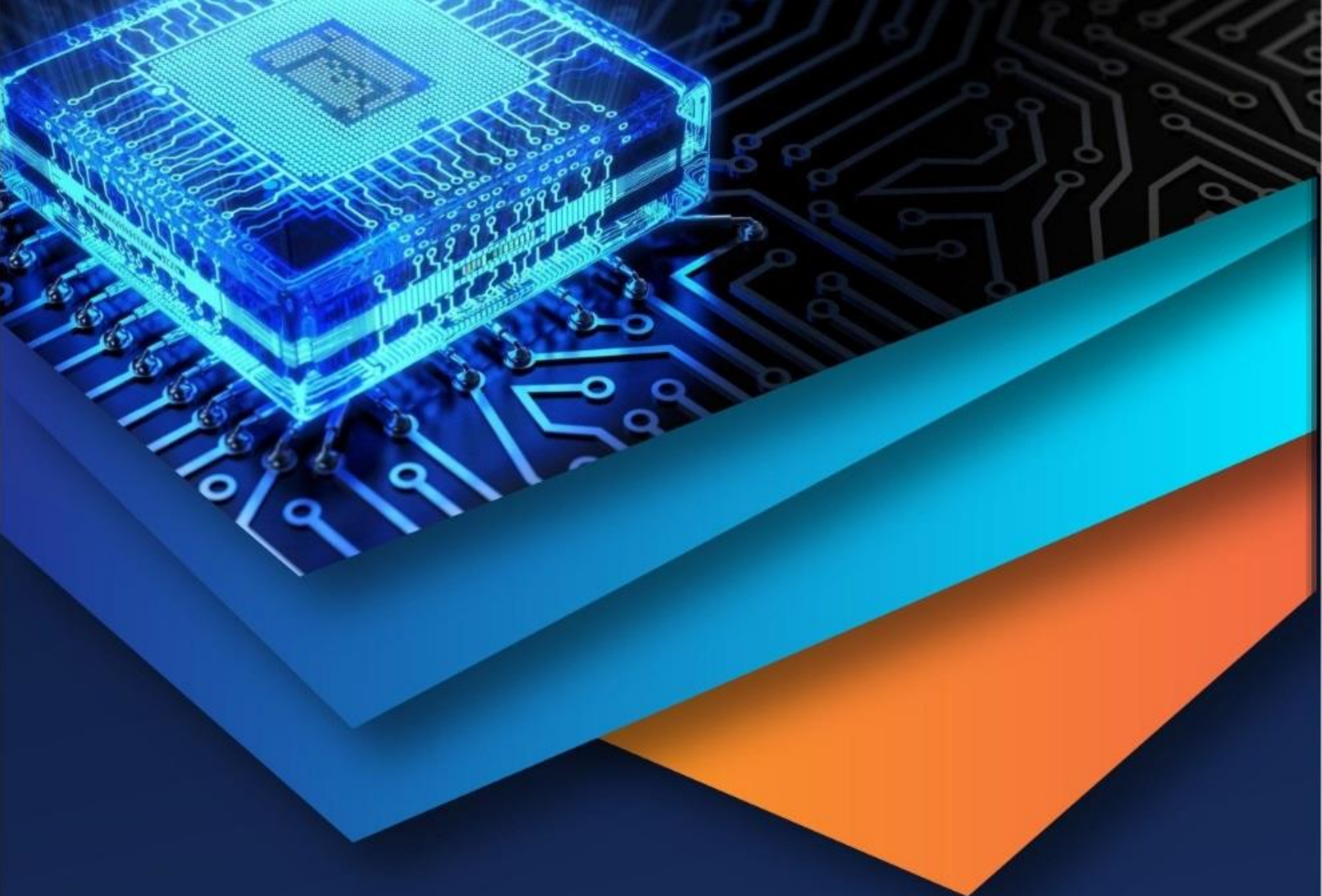

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