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HOOKWORM DETECTION IN WIRELESS CAPSULE ENDOSCOPY IMAGE

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Abstract: Wireless capsule endoscopy (WCE) is a diagnostic technique to examine inflammatory bowel diseases. As one of the most common human helminth , hookworm is a kind of small tubular structure with greyish white or pinkish semi-transparent body. Automatic hookworm detection is a difficult task due to poor quality of images, presence of irrelevant matters, complex structure of gastrointestinal and various appearances in terms of Colour and texture. This project is explained with the detection of hookworm in human to cure and remove that in the human body. Hookworm infection seriously threatens human health, causing intestinal inflammation, progressive iron/protein-deficiency anaemia , mucosa damage and malnutrition of human. Hookworm infection in pregnancy can cause retarded growth of the foetus, premature birth and low birth weight. Hookworm in children can cause intellectual, cognitive and growth problems.

Keywords: Monochrome image, padding pixels, acquisition image, colorimeter

II. INTRODUCTION

Hookworms are estimated to infect more than 740 million people around the world, but most people who are infected are asymptomatic. Definite diagnosis is made by seeing hookworm eggs during stool examination, however sometimes its diagnosis can be missed. A human digestive system consists of a series of several different organs including the oesophagus, 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. To specifies the problem, Wire- less Capsule Endoscopy (WCE) was first proposed in 2000, which integrates wireless transmission with image and video technology. The WCE is swallowed by the patient. After a WCE is swallowed by a patient who has a diet for about 12 hours , this little device moved by peristalsis starts to work and record the images while moving forward along the digestive. Meanwhile, the images captured by the camera are sent out wirelessly to a special recorder attached to the waist finally, all the image data in the special recorder are downloaded into a personal computer or a computer workstation, and physicians can view the images and analyse potential sources of different diseases in the gastrointestinal (GI) tract.

III. WORKING

IMAGE ACQUISITION:

Digital image acquisition imply or include the processing, compressing, storage, printing and display of such images. Digital imaging conveys the information that constitutes the image. In all classes of digital imaging, the information is converted by image sensors into digital signals that are operated by a computer and made output as a visible-light image. The two-dimensional image is a monochrome image which has been digitalised. Describe image as a two-dimensional light intensity function. f(x,y) is proportional to the grey value of the image at that point. A digitised image is one where spatial and greyscale values have been made individually separate. Intensity measured a regularity spaced grid in x and y directions intensities sampled to 8 bits(256 values).

GREY IMAGE

A colorimetric (or more specifically photometric) greyscale image is an image that has a defined greyscalecolorspace, which maps the stored numeric sample values to the achromatic channel of a standard colorspace, is based on measured properties of human vision

GUIDED FILTER

In image processing, images are often decayed into a smooth base layer and one or more detail layers. The base layer reports intensity variations of image which is obtained by applying the filter on image. The difference between the original image and the base layer gives the

detail layer. Edge preserving decompositions can be used in various image processing such as detail enhancement, HDR compression, details fusion, etc. In image enhancement operation the base layer and the detail layer are processed in various methods and recombined. The quality of images for human viewing is improved by enhancement process. The guided filter has various set of parameters.

WIENER FILTER

In signal processing, the Wiener filter is used to produce an estimate of a desired or target random process. The Wiener filter reduces the mean square error between the estimated random process and the desired process.

GREY LEVEL CO-OCCURANCE MATRIX(GLCM)

Analysis with a large number of variables requires a huge amount of memory and computation power or a classification algorithm which over fits the training sample and generalizes poorly to new samples. Texture analysis aims to finding a unique way of considering the underlying characteristics of textures and represent them in some simpler but unique form, so that they can be used for robust, accurate classification and segmentation of objects. Grey level co-occurrence matrix is formulated to obtain statistical texture features. A number of texture features may be extracted from the GLCM. Only four second order features namely angular second moment, correlation, inverse difference moment are computed. These four measures gives high discrimination accuracy required for motion picture estimation.

CORRELATION: It conducts the calculation of the correlation of a pixel and its neighbour over the whole image means it computes the linear dependency of gray levels on those of neighbouring pixels.Range=[-1,1] and the formula is

$$Correlation = \sum_{i,j=0}^{N-1} P_{ij} \frac{(i-\mu)(j-\mu)}{\sigma^2}$$

CONTRAST: It conducts the calculation of the correlation of a pixel and its neighbour over the whole image means it computes the linear dependency of gray levels on those of neighbouring pixels. In the place of a perfectly positively or negative correlated image, the correlation value is 1 and -1.On behalf of constant image its value is Nan. Range=[-1,1] and the formula is

$$Contrast = \sum_{i,j=0}^{N-1} P_{ij} (i-j)^2$$

Energy

The energy is used for doing work, thus regular sequence. It makes use for the texture that calculates orders in an image. It provides the sum of square elements in GLCM. Its range is [0 1].The constant image its value is 1.The equation of energy is

$$Energy = \sum_{i,j=0}^{N-1} (P_{ij})^2$$

Homogeneity

It is shortly calls by the term HOM. It conducts the value that calculates the tightness of distribution of the elements in the GLCM to the GLCM diagonal. The equation is

$$Homogeneity = \sum_{i,j=0}^{N-1} \frac{P_{ij}}{1+(i-j)^2}$$

P_{ij} - Elements i,j of the normalized symmetrical GLCM

N - Number of gray levels in the image

C - The Correlation feature, sgn(x) - Sign of a real number

- x = -1 for x < 0
- x = 0 for x = 0
- x = 1 for x > 0

σ^2 - The variance of the intensities of all reference pixels in the relationships that contributed to the GLCM, calculated as:

$$\sigma^2 = \sum_{i,j=0}^{N-1} P_{ij} (i-\mu)^2$$

HISTOGRAM EQUALIZATION

This method usually increases the global contrast of many images, especially when the usable data of the image is constituted by close contrast values. Through this adjustment, the intensities can be distributed on the histogram. This allows for areas of lower local contrast to obtain a higher contrast. Histogram equalization executes this by effectively spreading out the most frequent intensity values.

ADAPTIVE HISTOGRAM EQUALIZATION

Adaptive histogram equalization (AHE) is a computer image processing technique used to improve contrast in images. The adaptive method computes several histograms, each corresponding to a distinct section of the image, and uses them to redistribute the lightness values of the image.

IM2BW(BLACK AND WHITE IMAGE)

It changes an image to a binary image, based on threshold.

- im2bw makes binary images from indexed, intensity, or RGB images.
- BW = im2bw (I, level) changes the intensity image I to black and white.
- BW = im2bw(X, map, level) changes the indexed image X with colour map to black and white.

BW = im2bw (RGB, level) changes RGB to black and white

IMAGE QUALITY ASSESMENT

Image quality assessment is related to image similarity assessment in which quality is based on the differences (or similarity) between a degraded image and the original image, unmodified image. Well-known objective evaluation algorithms for measuring image quality indicate mean squared error (MSE) and peak signal-to-noise ratio (PSNR). MSE & PSNR are very simple and easy to use.

MEAN SQUARED ERROR(MSE): One obvious way of measuring this similarity is to compute an error signal by subtracting the test signal from the reference, and then measuring the average energy of the error signal. This metric is frequently used in signal processing and is defined as follows

$$MSE = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}(x(i,j)-y(i,j))^2$$

Where x (i,j) represents the original (reference) image and $y(i, j)$ represents the distorted (modified) image and i and j are the pixel position of the M×N image. MSE is zero when $x(i, j) = y(i, j)$.

Peak Signal to Noise Ratio (PSNR)

The PSNR is measured in decibels and is inversely proportional the Mean Squared Error.

It is given by,

$$PSNR = 10\log_{10}\frac{(2^n-1)^2}{\sqrt{MSE}}$$

Average Difference (AD)

AD is the average of difference between the reference signal and test image.

This metric is frequently used in signal processing and is defined as follows

$$AD = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}(x(i,j)-y(i,j))$$

Maximum Difference (MD)

MD is the maximum of the error signal (difference between the reference signal and test image).

$$MD = MAX\left|x(i,j)-y(i,j)\right|$$

Mean Absolute Error (MAE)

MAE is average of absolute difference between the reference signal and test image.

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$$MAE = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}\left|(x(i,j) - y(i,j)\right|$$

Normalized Cross-Correlation (NK)

The closeness between two digital images can also be measured in terms of correlation function. Normalized Cross-Correlation (NK) measures the similarity between two images and is given by,

$$NK = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}(x(i,j) \times y(i,j))}{\sum_{i=1}^{M}\sum_{j=1}^{N}(x(i,j))^2}$$

Structural Content (SC)

SC is also correlation based measure and measures the similarity between two images. Structural Content (SC) is given by the equation

$$SC = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}(y(i,j))^2}{\sum_{i=1}^{M}\sum_{j=1}^{N}(x(i,j))^2}$$

MORPHOLOGICAL OPERATION

The value of each pixel in the output image is based on a comparison between the corresponding pixel in the input image and its neighbors. By selecting the size and shape of the neighborhood, you can construct a morphological operation that is sensitive to specific shapes in the input image. Dilation and erosion are two fundamental methods.

OPERATION	RULE
Dilation	The value of the output pixel is maximum value of all the pixels in the input pixel's neighbourhood. In a binary image, if any of the pixels is set value as 1, the output pixel is set as 1.
Erosion	The value of the output pixel is the minimum value of all the pixels in the input pixels neighbourhood. In a binary images, if any of the pixels is set as 0, the output pixel is set as 0.

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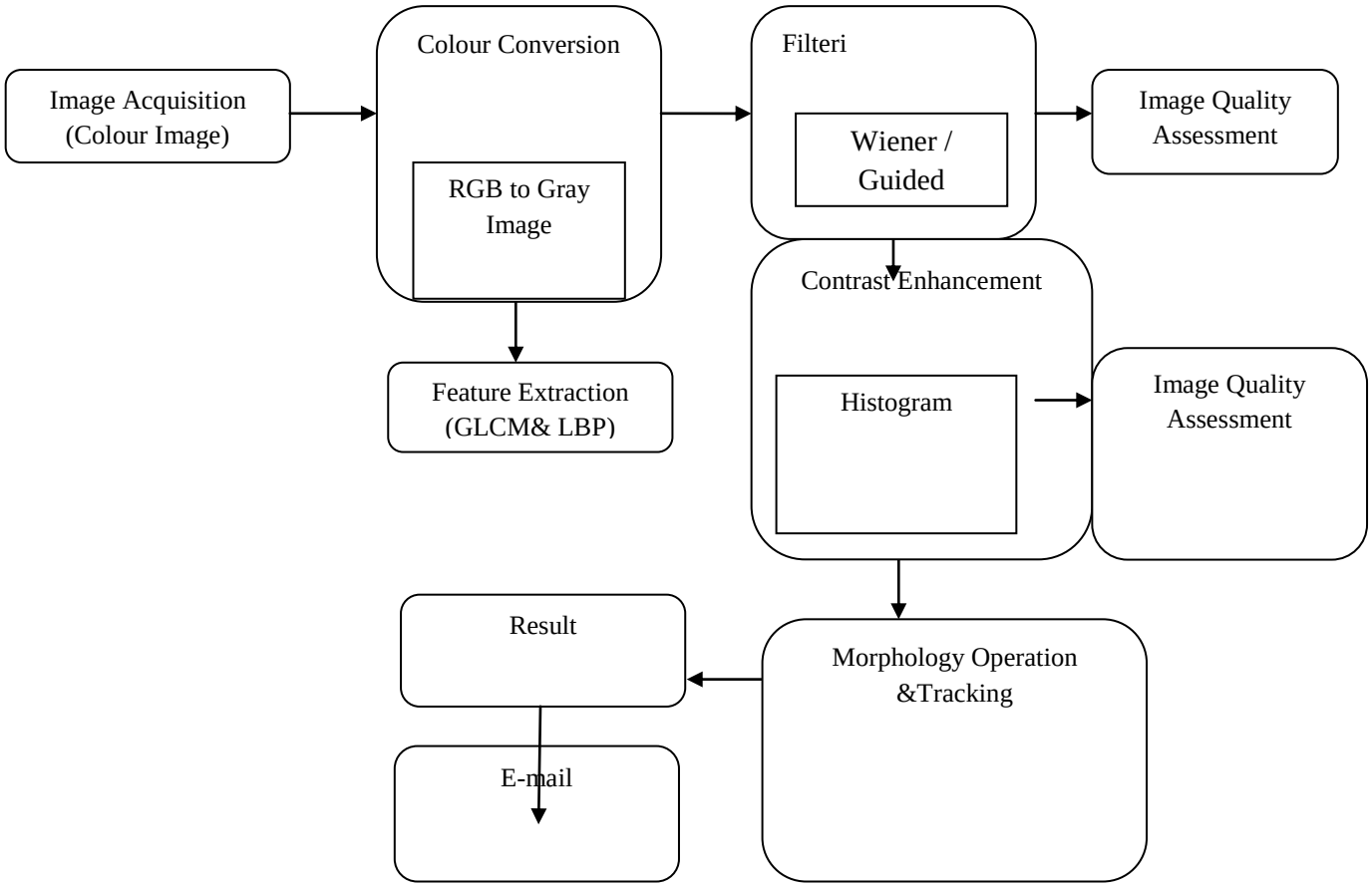
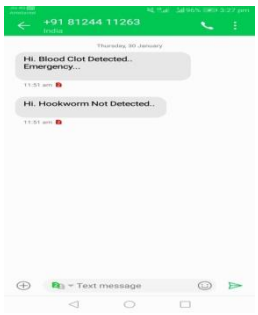
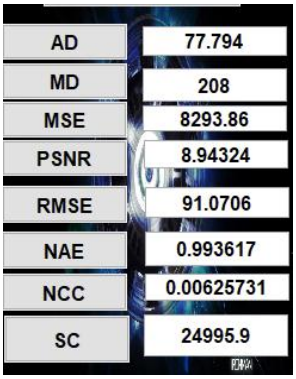
BLOCK DIAGRAM



RESULT

Comparing the output image with the original input image. We can determine whether the hookworm is present or not. If hookworm is present is indicated by the message "hookworm detected". If hookworm is not presented is indicated by "hookworm is not detected".





CONCLUSION: Hookworm can be detected using this new methodology includes many advantages than automatic hookworm detection. Finally it gives the good quality of images. It can be easily reachable to the patients using GSM module. The main disadvantages is it can be used only for limited number of images and capsule is not comfortable for all patient.

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