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MEDICAL IMAGE DENOISING USING ADAPTIVE MEDIAN FILTERS

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ABSTRACT
The manipulation of an image has become necessary for the purpose of either extracting information from the image or for producing an alternative representation of the image. The noise is an issue that gets introduced while transferring images through all kinds of electronic communication. The common noise in electronic communication is an impulse noise which is caused by unstable voltage. In this paper, the comparison of image denoising is discussed while applying it to the different medical images along with the calculation of various parameters before and after processing. The method will preserve the primary image details while suppressing the impulsive noise. This technique is being applied and analysed on various simulated images using MATLAB. However, the quantitave comparison is being done on the basis of calculation of PSNR, MSE, RMSE and Mean Absolute Error.

KEYWORDS: impulse noise, MATLAB, PSNR, MSE,RMSE, Mean Absolute Error.

INTRODUCTION
The purpose of this proposed approach is to demonstrate the technical feasibility of using digital image processing technique for the analysis of the medical images of the patients and to examine the reliability of image denoising algorithm. A class of patients suffering from Cholelithiasis have been selected and worked upon. The occurrence of Cholelithiasis is the commonest biliary disease to be reported in India. Our research is aimed to apply the potential of image processing in diagnosing the presence of gall bladder stones. In this work we have proposed a technique, a combination of preprocessing morphological techniques and Entropy calculation of the pixels representing gallstones in the gall bladder. Image processing can be defined as the manipulation of an image for the purpose of either extracting information from the image or producing an alternative representation of the image. There are numerous specific motivations for image processing but many fall into the following categories: (i) to remove unwanted signal components that are corrupting the image and (ii) to extract information by rendering it in a more obvious or more useful form. Extending the previous success in the areas of medical image processing, this project seeks to develop an algorithm that will outperform the technique of medical image processing. Images are always preferred to texts in multimedia transmission but all these communications
face a common problem: "Noise". One of the most common form of noise is the impulse noise, also known as salt and pepper noise which is caused by unstable voltage which is due to transmission or errors generated in the communication channel. The impulse noise produces fixed values in the pixels which are 0 (pepper noise) and 255 (salt noise). The noise model for an impulse noise can be expressed as:

$$x(i) = 0 \text{ ; for probability } p(n)$$
$$255 \text{ ; for probability } p(p)$$

$$= \varnothing \text{ ; for probability } (1- p(n) + p(p))$$

where $x(i)$ denotes the pixel of corrupted image, $p(n)$ and $p(p)$ are the probabilityof the pixel corrupted with pepper noise and salt noise respectively, where $p(n)$ and $p(p)$ = 1/2*Noise Ratio, where Noise ratio lies between 0 and 1.

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However, the noise filtering techniques can be of linear or non-linear types. The linear filtering technique is generally applied to the algorithm linearly to all the pixels that are present in the image without defining the image to be consisted as corrupted or uncorrupted pixel. Since the algorithm is applied to all the pixels in the image, this leads to the uncorrupted pixels to be filtered and hence these filtering techniques are not effective in removing impulsive noises. On the other hand, non-linear filtering technique defined by many researchers is a two phase filtering process. In the first phase, the pixels are identified as corrupted or uncorrupted pixel and in the second phase, the corrupted pixel is filtered using the specified algorithm while the uncorrupted pixel value is retained. The most widely used non-linear filter is the median filter which uses the median value to replace the corrupted pixel, and these filters have the capability to remove impulsive noise while preserving the edges.

METHODOLOGY

For the purpose of study, we have chosen the patients who are suffering from gallstones as the subject. Gallstone diseases are one of the most common biliary diseases, demanding a great progress in understanding the gallstones. The historical background of Cholelithiasis helps the researchers for easy classification of Gallstones [2]. According to Japanese, there are two types of Gallstones widely discussed: the Cholesterol stone, which is further of three types, the Pure Cholesterol stone, the Combination stone and the Mixed stone. Second is the Pigment stone, which is further classified as the Black stone and the Calcium Bilirubinate stone. The division line between Cholesterol and the pigment stones depends upon the proportion of Cholesterol. If the proportion of cholesterol is equal to or more than 70% then the stone is a Cholesterol stone; otherwise the stone is a pigment stone with calcium bilirubinate as its principal constituent. However, on the basis of their site of presentation gallstones can also be classified as Primary stones and the Secondary stones [2]. If the stone is viewed in its original site, it is called as Primary stone and if it has migrated from its original site, it is called as Secondary stone. The common manifestation faced towards Gallstones includes biliary pain, gallbladder inflammation, pancreatitis, and even bile duct obstruction. Several techniques have been developed to enable CT, MRI and ultrasound scanning software to produce 3D images for the physician [4]. We have taken some ultrasound images of the patients in the supine position of those having gallstones. After then, we use MATLAB 32-bit programming language to accomplish the medical Image Enhancement which is one of the techniques of digital image processing with great significance in medical electronics [6, 7]. The technique of Image enhancement satisfies the aim of improving the interpretation of information present in the images.

Pre-processing

The techniques of image enhancement are broadly classified as spatial domain methods and frequency domain methods [8]. In spatial domain methods, the pre-processing step refers to the plane of the image itself and manipulation of each pixel in an image. The spatial domain operations include spatial filtering of the image and the intensity transformation. For the purpose of preprocessing, we have started with the grey level mapping of the image, in which is the intensity transformation of the image pixels is done in context to spatial domain operations. It is applied to get the detailed resolution of the tissue patterns for pattern analysis and recognition. This has also differentiated between the speckle noise present in the image and the tissue patterns on the basis of which, it will help to indicate the tissue abnormality. This process of point processing is also known as pixel processing in the context of grey scale images. It intends to alter the grey levels at the spatial location of the pixels resulting into new grey scale levels which follows grey level adjustment. In Grey level adjustment, the thresholding of an image is done, where the object pixel is labeled with a value of "1" and a background pixel is labeled with a value of "0" [9]. We use threshold filter to set the high contrast of grey scale images into black and white images in order to distinguish between the areas. Then we use the histograms in order to analyze the grey level adjustment along with the visualization of pixels of each value and minor components.

Textural features

The textural features help to characterize the various regions of the image on the basis of their textures [10]. The texture analysis of any image can be characterized by range, standard deviation, entropy of the image, these values in combination gives the local variability of the intensity values of the image [10]. In our approach we will use rangefilt () function, entropyfilt() function, and unsharp() function for the purpose of texture filtering and to measure the statistical randomness. After then we will set the segment of the image and try to detect the stone. Then the area of the stone, its mean intensity and its position has been tried to be calculated.

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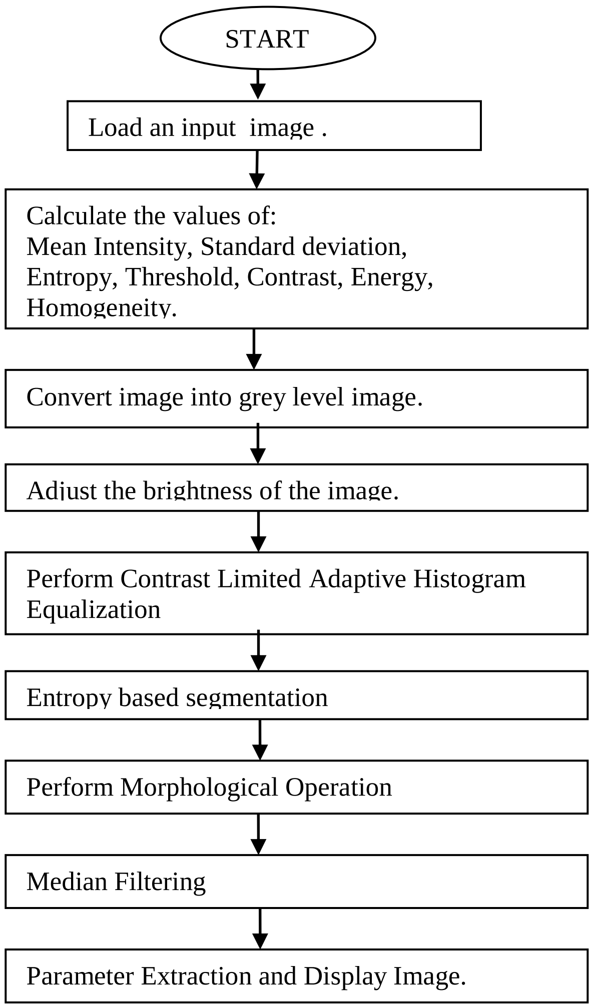
Eroding and dilating

Eroding and dilating are the two morphological operations which are being used in this approach to improve the clarity of the image. The erosion and dilation operations are done on the small matrix of numbers called as structuring elements or the kernels. The structuring erosion operation proceeds to the conversion of the pixels of the boundary into the pixels of the background. And dilation procedure is used for changing the pixels that are bordering the background image pixels. The erosion process generally makes the image smaller, however the dilation is used for enlarging or merging the objects [10].

PROPOSED ALGORITHM

Since the images of the ultrasound have typical ranges of luminance and brightness therefore it requires some levels of processing for better visualization and understanding. In order to visualize the dynamic range of any image and to preserve its subjective perception, an interactive algorithm to map the visualized original values of any image is given as follows.



RESULTS AND DISCUSSION

The above mentioned procedure has been applied to the two images of the patients and the window-wise results have been displayed.

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Table1.Window-wise results

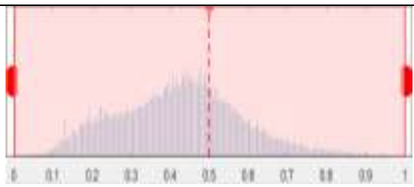
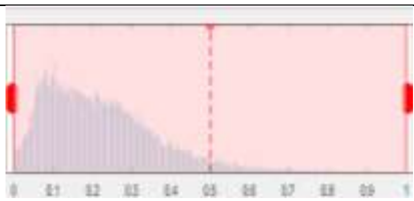
FIG	**ORIGINAL FIGURE**	**REMOVED LABEL**	**ADJUSTED DATA**	CONTRAST ENHANCEMENT	FILTERED IMAGE	ENTROPY BASED SEGMENTATION
1.						
2						

Table2. Comparative Values

IMAGE NO.	PARAMETERS FOR ORIGINAL IMAGE	PARAMETERS FOR ROI EXTRACTED DATA	PARAMETERS FOR GLOBAL THRESHOLD PROCESSED IMAGE	PARAMETERS PREPROCEESING via MEDIAN FILTER	PARAMETERS FOR FINAL SEGMENTED IMAGE	PARAMETERS FOR CHECKING SEGMENTED IMAGE AGAINST ORIGINAL
Image 1	Standard deviation : 0.243208 Entropy :6.138051 Threshold : 0.286275 Contrast : 0.192218 Energy : 0.189839 Homogeneity : 0.912452	Standard deviation : 0.277296 Entropy :4.289873 Threshold : 0.305882 Contrast : 0.746691 Energy : 0.340064 Homogeneity : 0.863942	Standard deviation : 64.471231 Entropy :4.607514 Threshold : 0.262745 Contrast : 0.615319 Energy : 0.317357 Homogeneity : 0.869599	Standard deviation : 62.365912 Entropy :4.629437 Threshold : 0.250980 Contrast : 0.179534 Energy : 0.330607 Homogeneity : 0.933045	Standard deviation : 0.000000 Entropy :- 0.000000 Threshold : 0.000000 Contrast : 0.000000 Energy : 1.000000 Homogeneity : 1.000000	PSNR = +57.6289 dB MSE = 0.1131 RMSE = 0.3364 Mean Absolute Error = 0.2323
Image 2	Standard deviation : 0.250043 Entropy :5.779766 Threshold : 0.254902 Contrast : 0.306594	Standard deviation : 0.251101 Entropy :3.973157 Threshold : 0.258824 Contrast : 0.477670	Standard deviation : 60.621958 Entropy :4.112694 Threshold : 0.247059 Contrast : 0.334031	Standard deviation : 71.106964 Entropy :4.022758 Threshold : 0.296078 Contrast : 0.167630	Standard deviation : 0.00 Entropy :0.00 Threshold : 0.00 Contrast : 0.00 Energy : 1.00	PSNR = +57.7281 dB MSE = 0.1106 RMSE = 0.3325 Mean Absolute Error =

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	Energy : 0.282883 Homogeneity : 0.913145	Energy : 0.450499 Homogeneity : 0.891991	Energy : 0.435472 Homogeneity : 0.909363	Energy : 0.456189 Homogeneity : 0.950316	Homogeneity : 1.00	0.2192

CONCLUSION AND FUTURE SCOPE

In comparison with the existing methodologies, our proposed approach has worked promisingly for the image enhancement of the gallbladder image along with the calculation of input and output entropy. However, the application of this approach can be extended for the diagnosis of different diseases other than Cholelithiasis.

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