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Denoising Technique of CT, MRI Abdominal Images Using Block Matching and Hybrid Filter.

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ABSTRACT

De-noising technique is the process of reduction of degradation in a medical images. As most of the medical images contains noises it becomes difficult for doctors to know the exact information from the image. Though restoration algorithms are used there are still some issues like edges are affected, images look blurred and the pixel values are disturbed. So in this paper we proposed the Block Matching Algorithm along with Discrete Wavelength is used. Hybrid Filter is implemented on Neural Network Technique to estimate the original image from the degraded data and various quality measures like PSNR, MSE and SSIM are calculated and input image and output image are analysed.

Keywords*:* MRI, CT, Degradation, Hybrid filter.

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INTRODUCTION

In common, Image Processing is a type of signal processing for which the input is image. The output may be either an image or a group of distinctive features chronicle to the image. The software used to run image processing is MATLAB. Matrix laboratory is a responding software system. It is used in computing mathematical functions, visualization and acts as might-full language to provide a platform for technical computing. Medical image processing is the technique which is used to create images of the human body for practically managing health seekers. Medical imaging look forth the inly shapes that are concealed by the lanky, as well as to diagnose and be-handle affliction. Medical imaging also enact as a databank of conventional anatomy and natural science to make it possible to identify aberrant. Imaging technology in medicine mode allows the doctors to see the interior portions of the body for easy diagnosis. The modality used are x-ray, ultrasound, CT, MRI images. Various artifacts such as noises affects the quality of the image which make us difficult to know the correct and accurate information. So, to overcome this problem de-noising technique plays a vital role in improving the quality of medical imaging. The main aim of de-noising is to reduce as much as noise by not disturbing the important features.CT and MRI are the most significant modalities in medical imaging. These modalities are exposed to high radiation. Considering patient's health, its better opting a trivial feasibility radiation dose. After all, the dose has a direct influence on the quality of the image. Diminishing the exposure rise up the noise. Multiple distinct ideas for noise suppression in CT and MRI modalities have been under-seek.

IMAGE DEGRADATION

If an image is degraded and if the quality of the image reduces by blurring a method named Image.

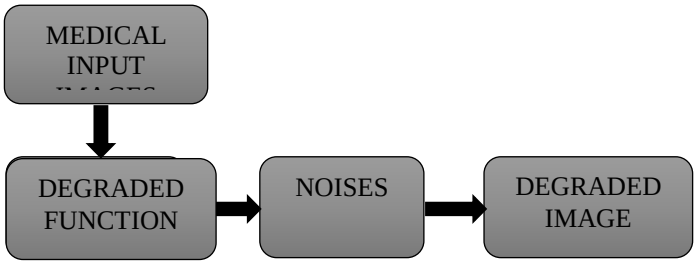

Fig 1 Image Degradation

Degradation is used to restore the original image from the degraded data The degradation function and additive noises are the main cause of blurring in an image. In mathematical terms it is expressed as

$$G(x,y) = H(,y) * F(x,y) + n(x,y)$$

Here, G(x,y) represents the degraded image, H(x,y) denotes the degradation function, F(x,y) is the original image and n(x,y) is the additive noise.

The weighty prerequisite in any noise reduction in medical imaging is to clinically applicable content must be protected. In specific, edges and tiny shapes should not be disturbed. Many edge preserving ideas for noise reduction in images are identified. The objective of all these method is to neither the noise power out-withing the smoothness throughout the edges. A few known example are bilateral filter (BF) and guided filter. In this study, the abdomen(KIDNEY) is been diagonised and an appropriate De-noising method to discard the Gaussian and Rician noise is used so that it is implemented for further processing such as segmentation, compression, recognition etc.

EXISTING SYSTEM

In earlier works, many filters and Algorithms are used for de-noise an image, prevent edges. The image is divided into layers and the pixel value is computed. The low-pitched noises and high-pitched noises are separated by their pixel values.

Lachine Mitiche in the year 2015 has proposed a paper on medical image de-noising using dual tree complex thresh-holding wavelet transform and wiener filter[1] It establish a de-noising approach based on dual tree complex riffle and shrinkage with the wiener filter technique. CWT performs the real and imaginary co-efficient are reckoned which gives the information about amplitude and phase information. The CWT along with Hilbert transform gives a recent enhancement called DTCWT. In wavelet, thresh-holding the noise can be expressed as

$$x = s + \sigma n_{ij}$$

The large coefficient equivalent to the signal and the small ones represents the noise. Wiener filter is used to replace the FIR filter to diminish noise in the signal. The wiener filter launches an ideal trade-off between inverse filtering and noise smoothing. It removes the extraneous noise and inverts the hazyness at same time. DTCWT along with wiener filter gives a better in protecting many topical arrangements, and hence gives the high quality of perceptual image.

H.S.Bhaduria in 2013 proposed a paper on medical image de-noising using adaptive fusion of curve-let transform and total variation [2]. Here, the adaptive fusion fuses the image by following methods - 1.Denoised by total variation, 2.Denoised by curve-let based method, 3.Edge information. The main objective is centred on noise suppression and edge prevention for CT and MRI images. Curve-let method is used to make the curved edges effectively. Two De-noising approaches are forth-put in curve-let domain 1. Curve-let de-noising using hard thresh-holding, 2. Curve-let de-noising using cycle spinning. The drawback was that noise suppression and edge preservation are contending objectives.

P. Natarajan in the year 2013 proposed paper on kidney segmentation in CT scan image [3]. In this histogram, equalization is performed to modify strength of the graphical value and to rise up the graphical values complicacy to get the ambiguity and a better value. High pass isolation is executed to discard high spatial often-ness noise from the graphical picture. Morphological function is performed at the end to acquire the portioned output. The downside is that thresh-holding leads to the ruining of significant data as a single threshold value is used for the partition. A quality measure such as PSNR value can be replaced instead of high pass filter in the pre-processing step.

Rajkumar Sahu in the year 2012 proposed a paper on wavelet based MRI image de-noising using thresh-holding techniques [4] In this paper the Discrete Wavelet Transform (DWT) of a graphical picture yields a non-redundant graphical pictures symbolize which caters meliorate spatial and spectral localization of a graphical picture. The DWT halts as signal decomposition in often-ness channel and it is then transited to the filter. Even though multiple wavelet thresh-holding degradation schemes are there, out of which the Haar wavelet with global thresh-holding cedes a venerable result on MRI brain images. The detraction is that detection of poor smooth curves and edges.

Flucka.O in the year 2011 published a paper on A Survey of medical image registration on graphics hardware[5] In this paper raising accomplishment of graphic processer and better programming strength have been splendidly executed. It gives an outline sketch to expedite GPU image registration. The motion image undergoes number of variations. The association between of motion and fixed image variation takes place. The different types of registration is done by the parameters which has efficient total to locate the alignment. The detraction is that tardy speed of GPU.

Daw-Tang Lin in the year 2006 proposed a paper on computer aided kidney segmentation on abdominal CT images[6] Here the surface of the kidney is procured based on shapes, quantitative measures and knowledge of internal structure. The spike like small units is diminished by using median filter. The examination of abdominal boundary, cluster location, the location of kidney surface is done. Adaptive region technique is used to partition the kidney from the abdominal image. The drawback in this paper is that Median Filter changes the pixel grey values.

Antoine Leory in the year 2004 proposed a paper on Rigid Registration of freehand 3D ultrasound and 3CT scan images of the kidney [7]. Here portray of CT scan is done and allows the examiner to perform 3D Diagnosis and formulation of actions before surgery takes place. Sobel Gradient filter is used in the pre-

processing of CT Image. The sticks filter is used for the diminishing of scattered noise from the ultrasonic picture. The detraction is that output was not that fulfilled in procuring IA slices and edges were disturbed.

PROPOSED WORK

In this proposed system various slices of kidney images as input are taken. One an ordinary CT/MRI image, the other is a perfused CT/MRI image which contains Gaussian and Riccian noises. Then a pre-processing technique takes place which is used to correct and adjust the digital images. In this process conversion of colour, size can be done. Image pre-processing is a process that adds quality of the images and make more suitable for analysis. It includes removing low frequency noise, standardize the strength of each particles images, reflections, and masking portions of images. Then the next process is Digital Image Registration. In this method one of the image is rotated and it is made to geometrically align with the other image. The main objective of this process is to align manifold graphical pictures of the identical topic to set up a relationship between their features. The motion of two images is performed by Block Matching Algorithm. In this process the images are separated into many blocks and their pixel values are found. The amount of motion is estimated through block by block basis Then suppression of noise is been performed and hence checked if there is no change in the pixel values of the original image compared to that of the separated block images. Along with this process Discrete Wavelength Transform (DWT) is calculated in mathematical terms and functions. Then the proposed Hybrid filter is the combination of two filters such as Edge prevention filter and bilateral filter is used to discard noise from the predicted image. To minimize the noise to a certain level Biological Artificial Neural Network is preferred so as to optimize the noise suppression.

The quality of the image can be evaluated by quality measurements such as Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR), Standard Deviation Ratio (MSR), Structural similarity (SSIM).

Calculation of GPU time and CPU time is done at the end. GPU time is used to expedite the calculation to decrease the execution time.

ARCHITECTURAL DIAGRAM

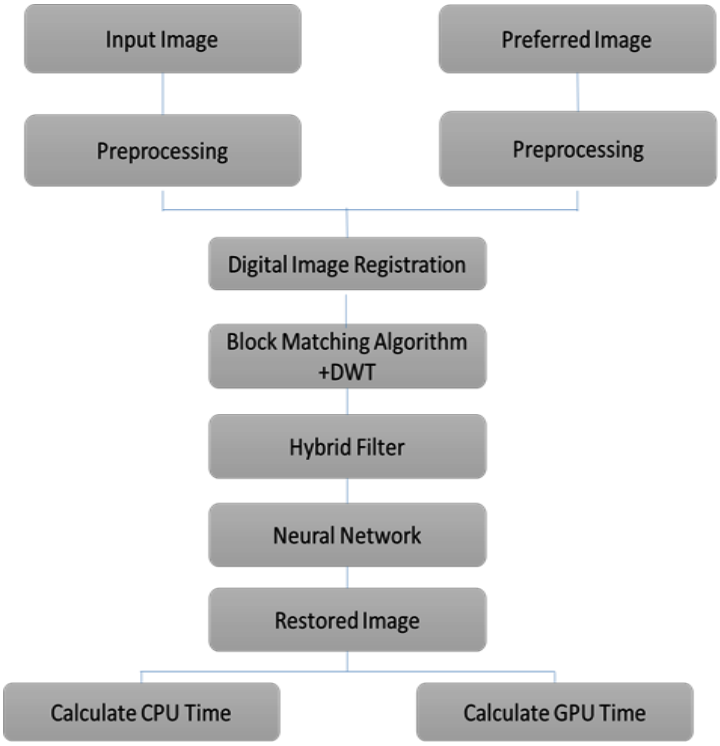

Fig 2 Overall Framework

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INPUT IMAGES

Two input images are taken**.** The images can be of jpeg or bmp formats so that MATLAB can access it. In this paper, Medical images (CT/MRI) are preferred. The actual images will be in the Red Blue Green (RGB) values.

PREPROCESSING

The digital images can be corrected and adjusted by pre-processing. The size of the original image adapted by resize technique which includes pre-processing of the image. Two sources of image data are image processing system and resize image data. The pre-processing is a sort of effective approach for image resizing, which conserves image message well and does not stimulate obvious deformation when changing the facet ratio of images.

Transition of a colour image to grayscale is not unique, different weighting of the colour channels effectively shows the upshot of shooting black and white flick with unique coloured photographic filters on the cameras. A communal strategy is to tally the brightness of the grayscale image to the brightness of the colour image. To convert a grey strength value to RGB, set all the three primary colour elements red, green and blue to the grey value, correcting to a different gamma if necessary. A grayscale or grayscale digital image is a graphical picture in which the measure of individual pixel is a personal sample, that is, it carries only strength information. Images of this type are also named as black and white, and it is exclusively made up to shades of grey, varying from black at the weakest strength to white at the extreme. Grayscale pictures are also called monochromatic, denoting the absence of any chromatic variation.

IMAGE REGISTRATION

Image registration is the process of covering two or more images of the same aspect taken at different times, from different viewpoints, and by different detectors. It geometrically align two images, the reference image and perceived image. Escalate based methods register is whole images or sub images. If sub images are registered, centre of corresponding sub images are tempered as corresponding feature points. Characteristic based method, establishes number of points in an image.

BLOCK MATCHING ALGORITHM

The appraisal movement between two images can be performed using block matching algorithm. It finds the similarity between 2 images, a whole block is considered as K. Then we assume that K block pixels are framed as K+1 by the movement in block of pixels. Then the blocks in (K+1) frames are (16*16/ 16*8/ 8*16/ 8*4/ 4*8/ 4*4) and finds out where the next block have to be moved using the motion vector. In this process a partial noise will be removed.

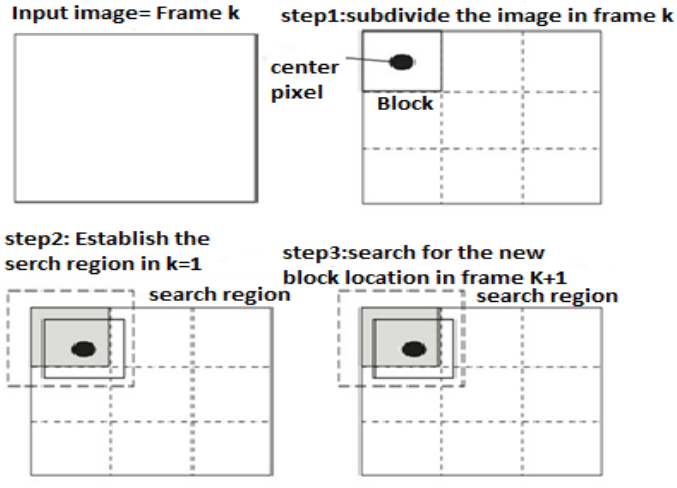

Fig 3 Block Matching Algorithm

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Discrete Wavelength transform is used to calculate mathematical functions and find a suitable formula to reduce the noise. Then pad-array is applied on 2D convolution to get a de-convolution image.

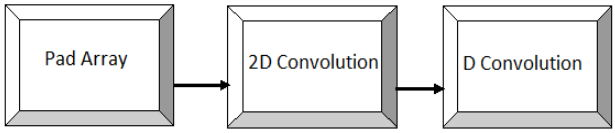

Fig 4 Discrete Wavelength Transform Block Diagram

HYBRID FILTER

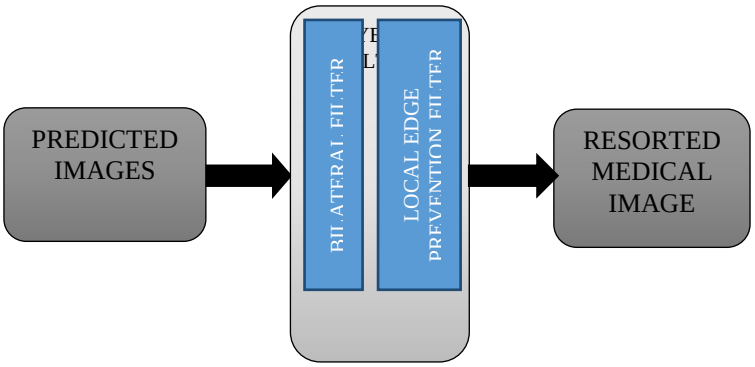

Fig 5 Block Diagram of Hybrid Filter

BILATERAL FILTER

Bilateral Filter (BF) is the weighted average of all the pixels.

$$BF = 1/ W_P \sum G\sigma_s (\|p-q\|) G\sigma_r (\|I_p-I_q\|) I_p$$

^{W}p is the normalization factor and should be assured so that the pixel value equals to 1.
The grey level at P is denoted by I_p
The grey location is I_q
$G\sigma s$ and $G\sigma r$ stands for Gaussian kernals for domain and range of image functions.

The main idea of the Bilateral Filter is when a pixel manipulates another pixel, it should not only fill adjacent space but also have a common value. The execution of this filter rely on the parameters and it is hard to acquire the optimal parameters.

LOCAL EDGE PREVENTION FILTER

Edge preserving is a significant property in filters as it avoid aureole artifacts. Multi-scale is used to disintegrate a top layer from the last disintegrated base layer. The pertinent edges are no more manipulated as a enormous gradients of the entire image, and they are locally adaptable. The pertinent edge can be considered as enormous gradient locally. The disintegration process is not the same in locally pertinent edges. The tiny gradients will be disintegrated in to the base layer. The beneficial effects of LEP is that each layer increases and gives a brief knowledge about each layers. Image enhancement is done which upgrades the quality of the digital image. The main objective of LEP filter is that to uphold the details all over and to generate an image that is natural without noise.

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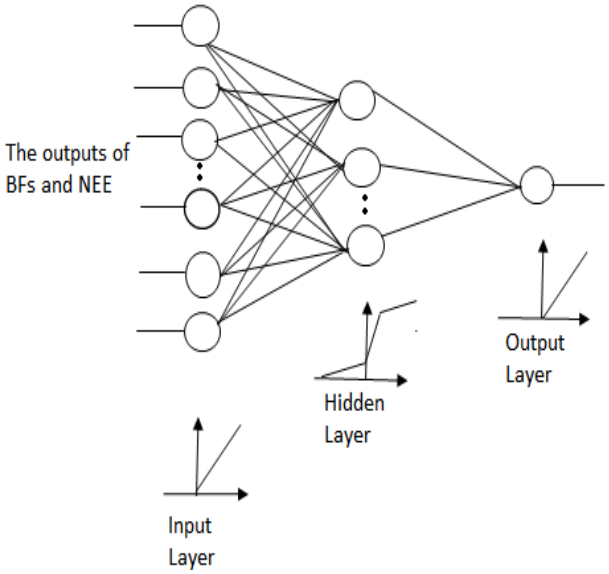

Fig 6 Artificial Neural Network

ARTIFICIAL NEURAL NETWORKS

Recently, important advancement has been made in applying a neural network in image processing. The neural network used in this process is Biological Artificial Neural Network. The Neural Processor is a kind of non-linear function. It operates on multilayer artificial neural network elements. By guiding the neural networks with a set of input signals and the resultant signals, it gains the function of a resultant filter. The neural filter have been classified as

Realized as stack filters – An input signal is modified to binary signals on the basis of thresh-hold reduction. Then each of the signal becomes an input to the plural multilayer neural networks. These results in reducing the impulsive noise from images.

The next classification of filter is input signals are directly sent to a multilayer neural network. It is feasible in diminishing Gaussian/Quantum noise from the images effectively.

Neural Network

$$F_E(x,y) = G_M\, NN[\{I(x-i,y-j) \mid G_M \mid I,j \text{ ع } R_S\}]$$

G_M is the Normalisation Factor
NN is the output of Modified Multilayer.

QUALITY MEASURES

To determine the difference and similarity between the input and destined output image we use certain quality measures. It estimates the match between the images. Some of them are,

Mean

The mean is the average of the numbers.

$\mu = \sum fx \,/\, \sum f$

where, N- Mean
f - Number of occurances
$\sum fx$ - Sum of products fx
$\sum f$ - Total number of occurances

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Variance

The spread between the numbers in a data set is estimated by Variance.

$$\text{Variance} = 1/N \sum_{i=1}^{n} (X^2\text{-}N^2)$$

Mean Square Error [MSE]

The average of the squares of the errors are measured by MSE.
It calculates the difference between the estimator and what is estimated.

$$MSE = 1/M_1N_1 \sum_{x=1}^{M1} \sum_{y=1}^{N1} |I(x,y) - I(x,y)|^2$$

$\bar{I} \xi R^{M1*M2}$ is the clear image without any noise.

Peak Signal to Noise Ratio [PSNR]

The PSNR represents a measure of the peak error.

$$PSNR = 10\log_{10} N_{max} / MSE$$

The maximum fluctuation in the input image is represented by $N_{max.}$

Structural Similarity

To evaluate the image quality SSIM is applied on colour.

$$SSIM = (2\mu\tilde{I}(x,y)\mu\bar{I}(x,y)+C_1)\ (2\sigma\tilde{I}(x,y)\bar{I}(x,y)+C_2) / \mu^2\tilde{I}(x,y)+\mu^2\bar{I}(x,y)+C_1)\ (\sigma^2\tilde{I}\ (x,y) + \sigma^2\bar{I}\ (x,y)+C_2)$$

$\mu\tilde{I}(x,y)$, $\mu\bar{I}(x,y)$, $\sigma^2\tilde{I}(x,y)$, $\sigma\ \bar{I}(x,y)^2$ and $2\ \sigma\ \bar{I}(x,y)\ \tilde{I}(x,y)$ are the means of $\tilde{I}$ and $\bar{I}$
C^1 and C^2 are small constants.

CALCULATION OF CPU AND GPU TIME

Central Processing Unit:

The Central Processing Unit (CPU) time is accountable for manipulating and for managing other parts of the system. It performs both logical and floating point operations.

Graphical Processing Unit:

The graphics rendering can be done performed in a programmable chip known as Graphical Processing Unit (GPU). The highly parallel GPU complex is more benefited as enormous blocks of data is performed in parallel than the common purpose of CPU. Block Matching Algorithm is implemented on GPU so as to reduce the complexity and to give a better output.

RESULTS AND DISCUSSION

The steps followed in De-noising the image is explained through the screenshots.

Step 1: Two input images are taken.

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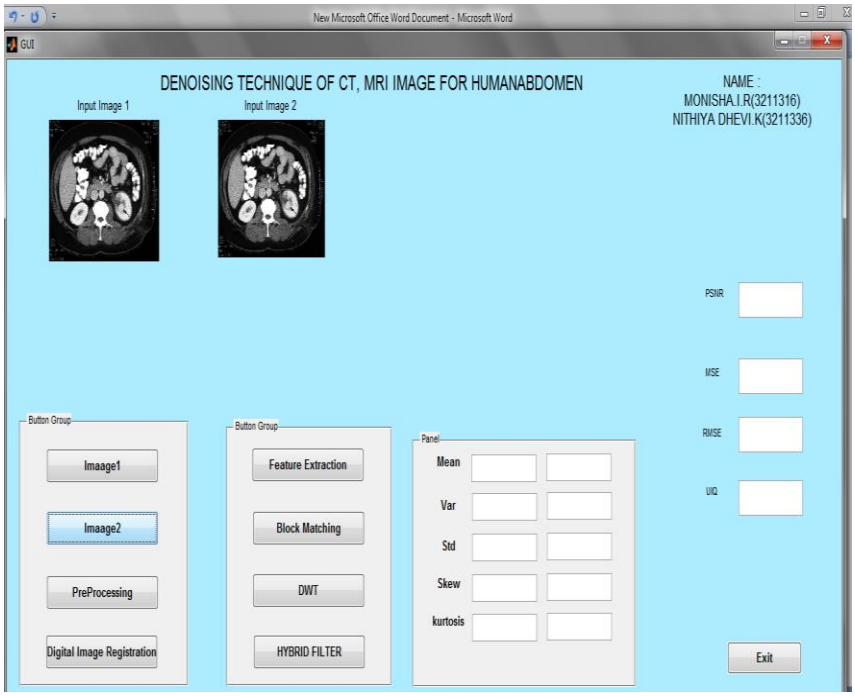

Fig 7 Screenshot of Input Images

Step 2: Pre-processing of images takes place where colour images are converted into grey scale images.

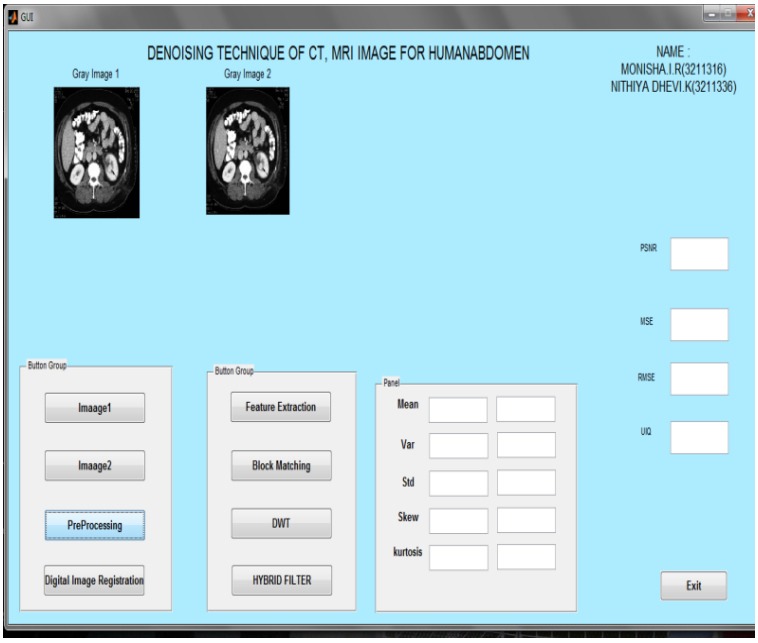

Fig 8 Screenshot of Pre-processing

Step 3: The slight misalignment between the input image and the pre-processed image is processed by Digital Image Registration so that to obtain perfect matching.

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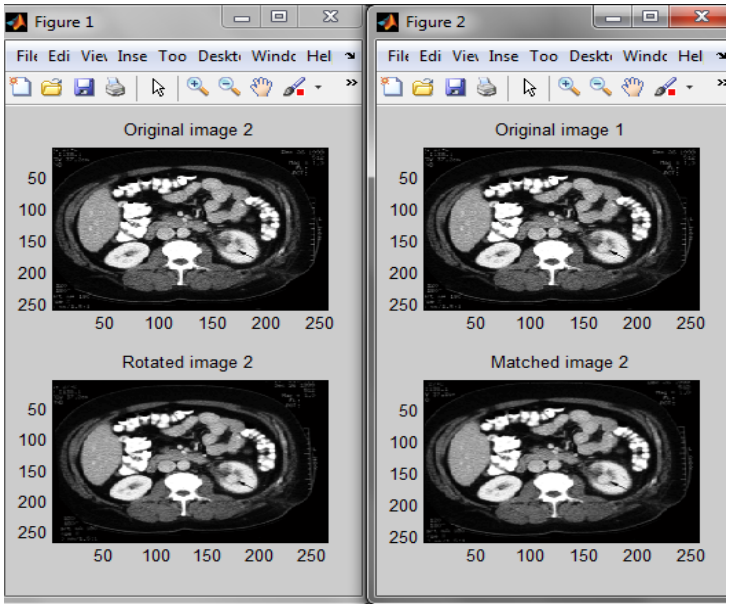

Fig 9 Screenshot of Digital Image Registration

Step 4: Block Matching Algorithm takes place to assess the values of two images and partial noise is removed in this process.

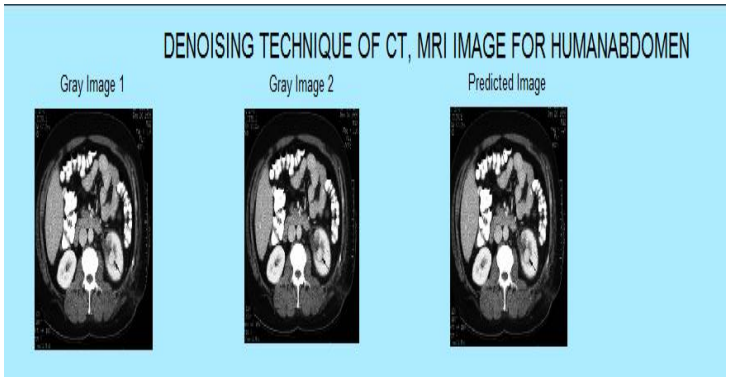

Fig 10 Screenshot of BlockDiagram

Step 5: Discrete Wavelength transform to obtain a De-convolution image take place.

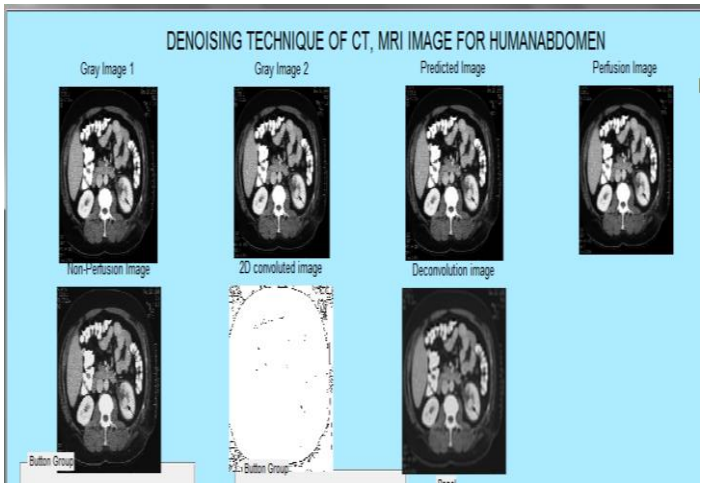

Fig 11 Screenshot of DWT

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Step 5: The combination of bilateral and local edge prevention filter is used to remove the noises and the image is restored.

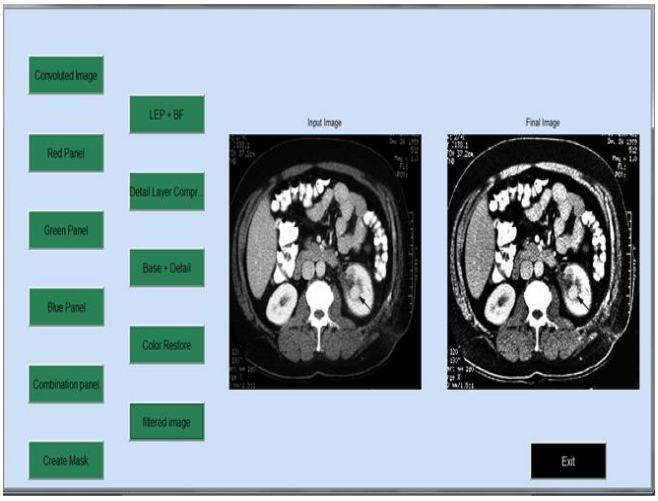

Fig 11 Screenshot of Hybrid Filter

CONCLUSION AND FUTURE SCOPE

The medical image de-noising is very humane and hence, the images are restored without noises at maximum level effectively. The images are processed by using Block Matching Algorithm and restoration filtering such as hybrid filter along with neural network is put forth so that important features such as edges are prevented and pixel value is raised. The optimization of noises are done. So that, it reaches the maximum level to get clear image. The original image is obtained from the degraded data by removing the noises efficaciously.

Using the next advanced technology and filters the noise can be reduced in the images such a way that doctors can find out the type of disease by examining the x-ray.

The output image can be further transformed to high dimensional image to view the crystal clear image without noise.

REFERENCES

[1] H.S.Bhaduria, M.L.Dewal. “Medical image de-noising using adaptive fusion of curvelet transform and total variation”, Elsevier, 2012.

[2] Hilal Naima, Amel Baha Houda, Adamou-Mitiche, LahceneMitiche,“Medical image de-noising using dual tree complex thresh-holding wavelet transform and wiener filter” , king saud university, 2015

[3] P.Natarajan,BhuvaneshPratap Singh, Shashank Dwivedi, ShraiyaNancy,”Kidney Segmentation in CT-Scan Image”, International Journal of Scientific &Engineering Research, Volume 4, Issue 6, June – 2013

[4] Shashikant Agrawal and RajkumarSahu,” Wavelet Based MRI Image Denoising Using Thresholding Techniques”, IJSETR,Vol.1,2012,pp.32-35

[5] Flucka.O,Kamena.A, Preimb.B, Vetter.C, Weina.W, Westermannc.R, “A survey of medical image registration on graphics hardware “, Elsevier, 2011

[6] Daw-Tung Lin,“ Computer-Aided Kidney Segmentation on Abdominal CT images”IEEE Trans. On Information Technology in Biomedicine , Vol. 10, No. 1 , Jan 2006

[7] Antoine Leory ,PirreMozer , Yohan Payan and Jocelyne Troccaz , ”Rigid Registration of Freehand 3D Ultrasound and CT-scan images of the Kidney”,springerVerlag Berlin Heidelberg , 2004

[8] Cheung. C. H (2003) ‘A New Cross Diamond Search Algorithm for Fast Block Matching Motion Estimation,’ Proceeding IEEE International Conference on Neural Networks and Signal Processing, Nanjing, China, vol.22, pp.1581,1584, 7-10 .

[9] Chun Ho Cheung and Lai Man Po (2002) 'A Novel Cross-Diamond Search Algorithm for Fast Block Motion Estimation', IEEE Trans. Circuits And Systems For Video Technology, Vol. 12, no.12, pp.1168, 1177.

[10] Westermannc. R (2011), 'A survey of medical image registration on graphics Hardware', Computer methods and program in biomedicine, Elsevier, Vol. 104, pp.45-5

[11] Lai Man Po and Wing Chung Ma (1996) 'A Novel Four Step Search Algorithm For Fast Block Motion Estimation' IEEE Transactions on Circuits and Systems for Video Technology, vol.6, no.3, pp.313,317.

[12] Mahalakshmi. S (2005), 'GPU Accelerated Medical Image Registration Techniques', (IJIRSE) International Journal of Innovative Research in Science & Engineering Department of Information Science and Engineering, BMS Institute of Technology Bangalore, India, ISSN (Online) 2347-320

[13] SebestienMazar, Jean Luc Dugelay and Renaud Pacalet (2006), 'Using GPU For Fast Block Matching', 14th European Signal Processing Conference (EUSIPCO), Florence, Italy.