International Journal of Trend in Research and Development, Volume 4(1), ISSN: 2394-9333
www.ijtrd.com

Enhancement of the Digital Image with Hybrid Approach Using Stationary Wavelet Transformation, Mean Filtering & Contrast Approaches Techniques

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Abstract-- In this paper we propose a hybrid noise removal approach using Stationary Wavelet Transformation (SWT), Adaptive Mean Filtering (AMF) and Contrast Approaches. The Wavelet Transform carry out a filter function on images. This paper represents a new computational scheme based on decomposition of the image into sub-bands using SWT technique to remove the noise from the image. We have considered different digital images in different format that are JPEG (), PNG (), BMP (), TIF (). In original image we have added 10 db noise. After adding the noise we have implement proposed technique & Discrete wavelet Transformation (DWT) technique on these different format of the image. We observe that the proposed technique gives better results than DWT. The contrast of the image is adjusted by using General Histogram Equalization (GHE), Singular Value Equalization (SVE).

Keywords-- *Image Enhancement, SWT, DWT, Gaussian Noise Edge Detection, GHE, SVE.*

I. INTRODUCTION

Presence of noise easily corrupts the digital image by noise due to conversion error of analog-to-digital and malfunction of pixel elements in the camera sensor. [5] The presence of noise degrades the image's quality. In successive processing noise increases the difficulties in many cases. So removal of noise is very important in images before successive processing. The image may be corrupted by different types of noise, so it is not an easy task to remove noise from image. In this paper hybrid technique is proposed using Stationary wavelet transformation for low frequency component of the image, edge detection algorithm to detect edge features of the image and contrast approaches to adjust contrast of the image.

Image Enhancement Image enhancement is a technique which is used to improve the interpretation of the information of the image so that the image can be easily understand by the observer. [3] The understand ability of the view of the image decreases due to the presence of noise. There are different Techniques to remove the noise from the image. Fortunately most noise added to image can be modelled by Gaussian noise. [8]

Gaussian noise Gaussian noise introduced in image at the time of acquisition of image. It is the statistical noise following Gaussian probability density. [9] Popular method to remove the Gaussian noise is Gaussian filter, however it blur the edges which may cause information loss in some visually important area. [11] To solve this problem we have propose a technique using Stationay Wavelet Transformation.

Image Noise Usually the image noise is that aspect of electronic noise which cause to have a random variations in brightness or colour information. Noise presence reduces the ability of observer in analysing the image. Image noise model is considered as

$$g(x,y) = f(x,y)+Ⴖ(x,y) \quad (1)$$

Where f(x,y) is original image, Ⴖ(x,y) is noise tern and g(x,y) is resulting noise pixel.

Edge Detection Edge detection is that fundamental application which is used to detect the edge from the analysis and the improved image. The detailed coefficient in an image represent the edges. The edges signify the local changes occur in the intensity of the image. The edges are exist at the boundary between two different regions in an image. The edges of the image like corner, lines, and curves extract the important features of the image.[13]

A. Contrast Stretching

The image is rescaled into brightness value with the use of stretch. The brightness value makes the drastic difference in the way that the image appears. The contrast stretching process is used adjust the contrast of the image. In this paper we have represent following to techniques for improvement of contrast of the image. [1]

General Histogram Equalization (GHE)

Singular Value Equalization (SVE)

II. RELATED WORK

Gholamreza Anbarjafari et al.(2015)[1]In this paper they propose a method to enhance image illumination using Gaussian distribution mapping which also keeps the information laid on the pattern of the histogram on the original image. First a Gaussian distribution based on the mean and standard deviation of the input image will be calculated. Simultaneously a Gaussian distribution with the desired mean and standard deviation will be calculated. Then a cumulative distribution function of each of the Gaussian distributions will be calculated and used in order to map the old pixel value onto the new pixel value. Another important issue in the field of illumination enhancement is absence of a quantitative measure for the assessment of the illumination of an image. The measure utilizes the estimated Gaussian distribution of the input image and the Kullback-Leibler Divergence (KLD) between the estimated Gaussian and the desired Gaussian distributions to calculate the quantitative measure.

Neha Tripathi, Krishna Gopal Kirar(2014) [2] in this paper they have introduced a new method which is based on interpolation of high frequency sub-bands. This frequency is obtained from DWT and SWT. In proposed technique the DWT is used to decompose an image into different sub-bands and from them the images with high frequency sub-bands are interpolate. After that the interpolated sub-bands coefficients are corrected by using the high frequency sub-bands which are achieved by SWT of the input image. SWT & DWT are the method of image resolution enhancement. The sub-bands with lower

frequency are interpolated with same interpolation factor. Then all the images are combined using DWT to generate a super resolved image.

Sayed Hani Hojjati, Mohammad Reza hasseinzadeh, Ali Reihanian (2014) [3] According to this paper a new method is described to reduce the noise and improve the contrast of medical image. Here they proposed an algorithm which is used for this enhancement that is based on wavelet transformation. They firstly used the Haar transform to obtain the image's detail. Then Stationary Wavelet Transform (SWT) is used to remove the noise from the image. After that the image is enhanced by using different methods of image fusion. Finally Contrast Limited Adaptive Histogram Equalization (CLAHE). This algorithm improves the quality of an image after removing its noise.

Tang Yong-Zheng (2014) [4] described that the result of a medical image is obtain in more accurate manner by fusion than other single medical image. He proposes a method of multi-focus medical image fusion based on improved redundant complex wavelet transform. The proposed multi-focus medical image fusion method integrates the pixel level fusion and some features level fusions. This method firstly decomposes multi-focus medical image fusion redundant wavelet transform (RWT). After that, to guide the organization coefficient it uses the extracted brink features. Finally RWT inverse transformation is use to reconstruct fusion medical image.

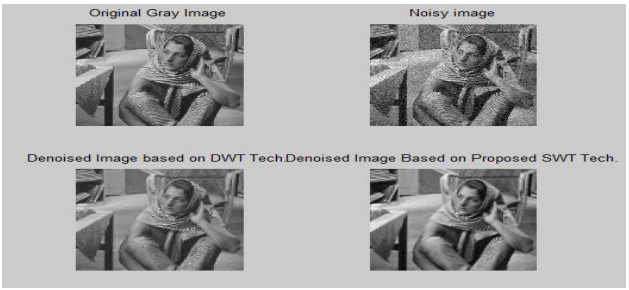
III. PROPOSED WORK

In this paper we have implemented proposed hybrid image enhancement algorithm using SWT, Mean Filtering & Contrast Approaches on the different format of the image that are JPEG, PNG, BMP, and TIF. The SWT and Mean Filtering technique is used to remove the noise from the image. GHE and SHE technique is used to improve the contrast of the image. During the implementation of proposed technique firstly we have taken an input image in JPEG, PNG, BMP, and TIF. We have been used db3 wavelet from family of db1, db2, db3, sym3, coif2, bior 2.Than 8 db noise is added in the original image. After adding the noise we have apply 3-level decomposition on noisy image using DWT & Proposed SWT technique to obtain the denoised image. From the results we observe that the proposed technique gives the better results as compare to existing one.

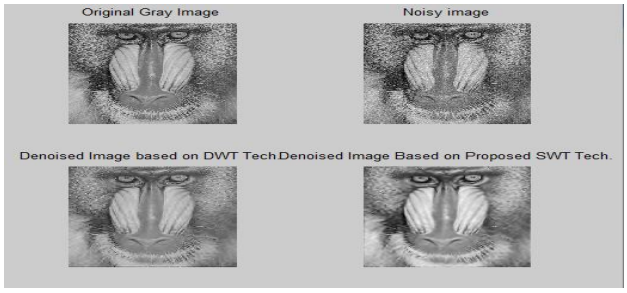
IV. EXPERIMENTAL RESULTS

A. Results of Implementation Of Technique On Different Format Of Images

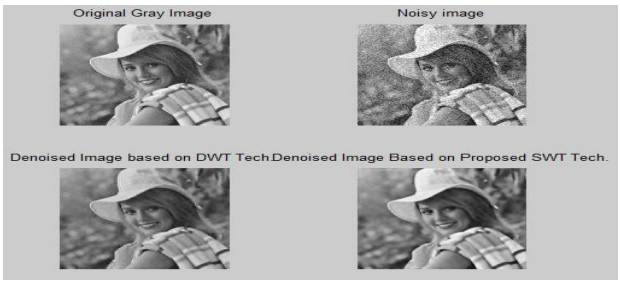
a. JPEG Format of Images



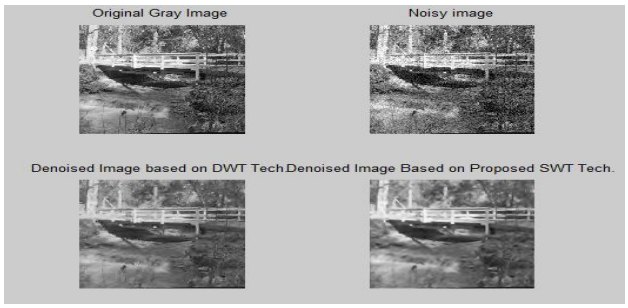
(a) Barbara.jpeg



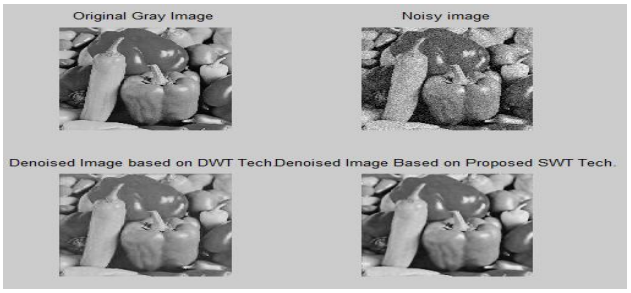
(b) Baboon. jpeg



(c) Elaine. jpeg



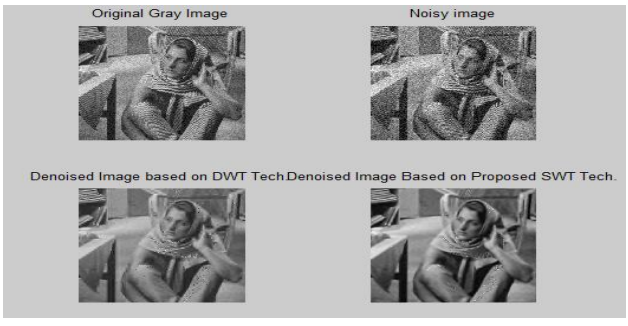
(d) Bridge jpeg



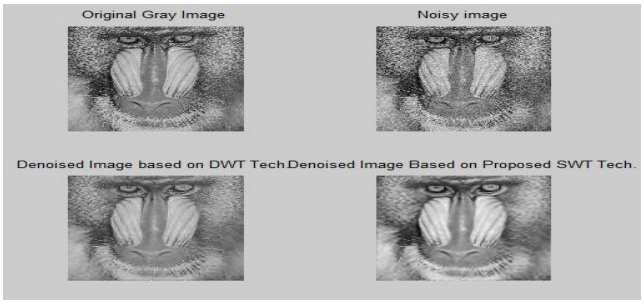
(e) Pepper. jpeg

Figure 1: Results of image enhancement algorithm (a) Original Image (b)Noisy Image (c) Denoised image using DWT Technique for Image Enhancement (d)Denoised image using DWT Technique for Image Enhancement

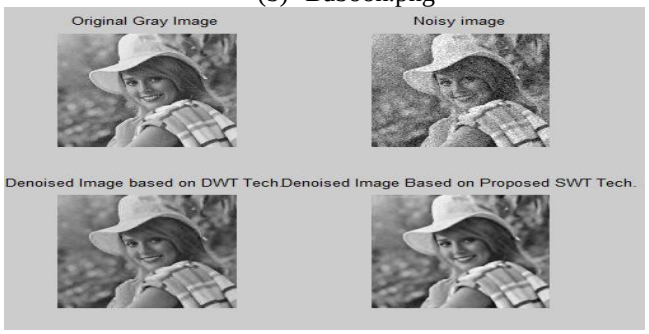
b. PNG Format of Images



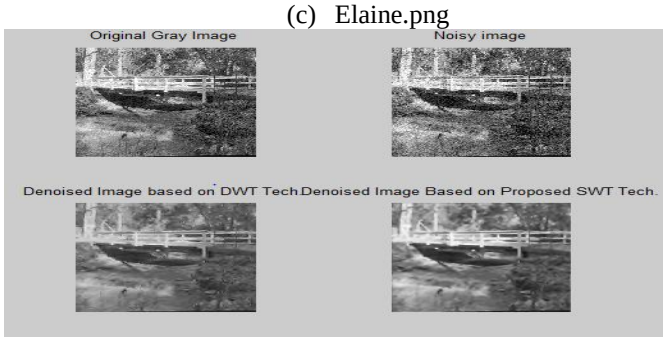
(a) Barbara.png



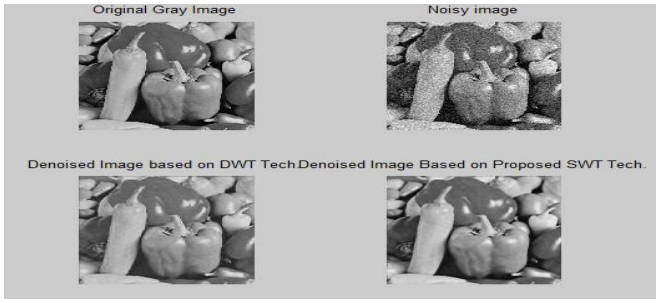
(b) Baboon.png



(c) Elaine.png



(d) Bridge.png

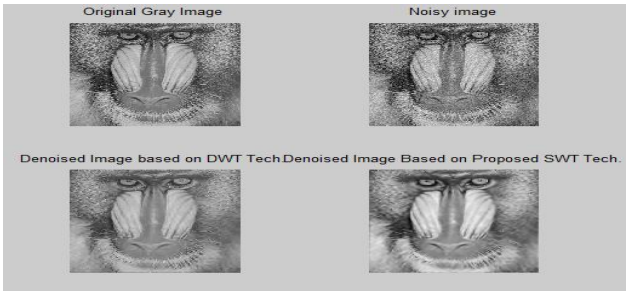


(e) Pepper.png

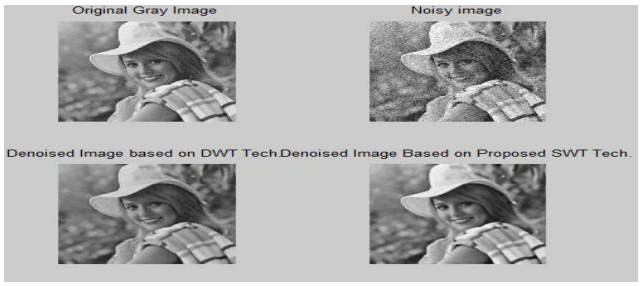
Figure 2: Results of image enhancement algorithm (a) Original Image (b) Noisy Image (c) Denoised image using DWT Technique for Image Enhancement (d) Denoised image using DWT Technique for Image Enhancement

c. BMP Format of Images

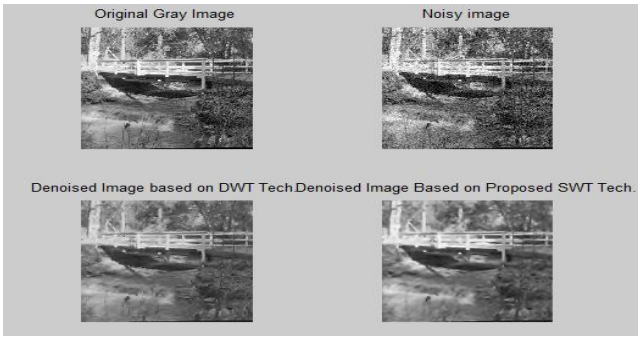
(a) Barbara.bmp



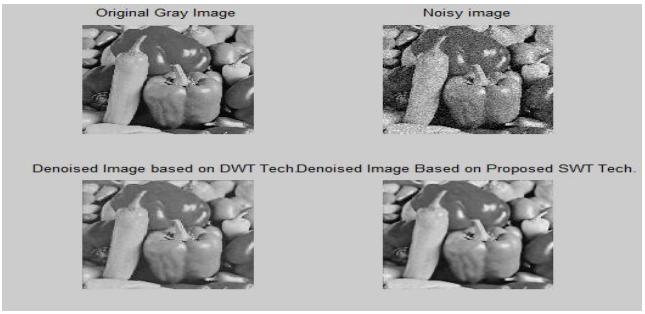
(b) Baboon.bmp



(c) Elaine.bmp



(d) Bridge.bmp



(e) Pepper.bmp

Figure 3: Results of image enhancement algorithm (a) Original Image (b) Noisy Image (c) Denoised image using DWT Technique for Image Enhancement (d) Denoised image using SWT Technique for Image Enhancement

B. Performance Evaluation Of Parameters

a. PSNR Evaluation Of Images Of Different Formats

Table 1: PSNR Values of JPEG Format Images

DENOISED BY SWT	DENOISED BY DWT	NOISY IMAGE	IMAGES
25.04	23.33	22.87	BARBARA
23.49	21.164	21.03	BABOON
30.54	29.05	22.92	ELAINE

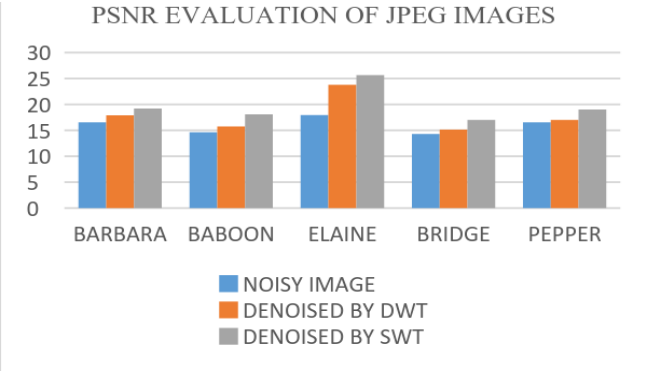
24.03	22.24	21.46	BRIDGE
26.16	24.25	22.87	EPPER

Table 2: PSNR Values of PNG Format Images

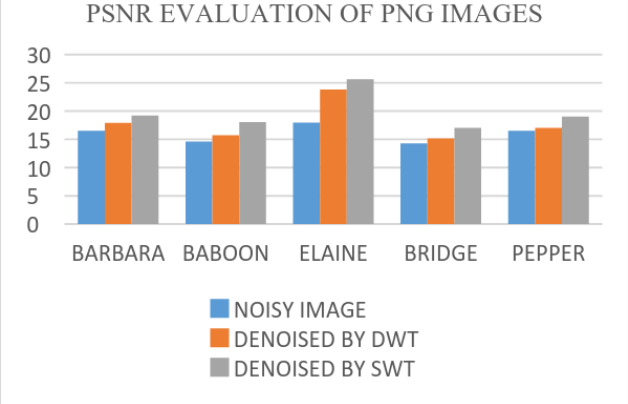
DENOISED BY SWT	DENOISED BY DWT	NOISY IMAGE	IMAGES
22.89	21.01	20.56	BARBARA
23.55	21.46	20.21	BABOON
30.68	28.41	22.92	ELAINE
22.25	20.41	20.21	BRIDGE
28.84	26.18	21.62	PEPPER

Table 3: PSNR Values of BMP Format Images

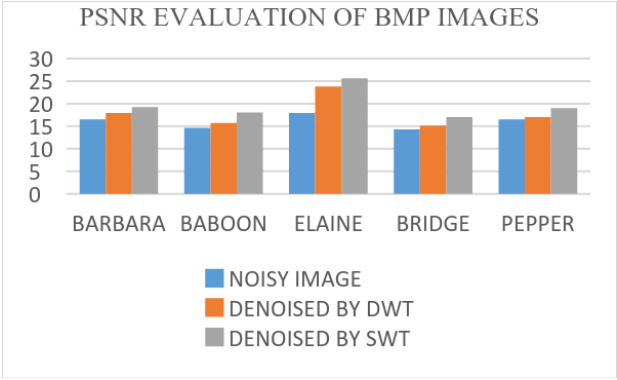
DENOISED BY SWT	DENOISED BY DWT	NOISY IMAGE	IMAGES
25.52	23.34	22.87	BARBARA
23.55	21.46	21.28	BABOON
30.6	28.89	22.92	ELAINE
23.07	22.28	21.49	BRIDGE
28.59	26.55	21.609	PEPPER



(a)



(b)



(c)

Figure 4: PSNR values of Noisy Image, Denoised image using DWT Technique, Denoised image using SWT Technique (a) JPEG IMAGES (b) PNG IMAGES (c) BMP IMAGES

b. SNR Evaluation Of Different Formats

Table 4: SNR Values of JPEG Format Images

DENOISED BY SWT	DENOISED BY DWT	NOISY IMAGE	IMAGES
19.22	17.91	16.54	ARBARA
18.068	15.74	14.606	BABOON
25.65	23.805	17.95	ELAINE
17.02	15.15	14.3	BRIDGE
19.02	17.01	16.54	PEPPER

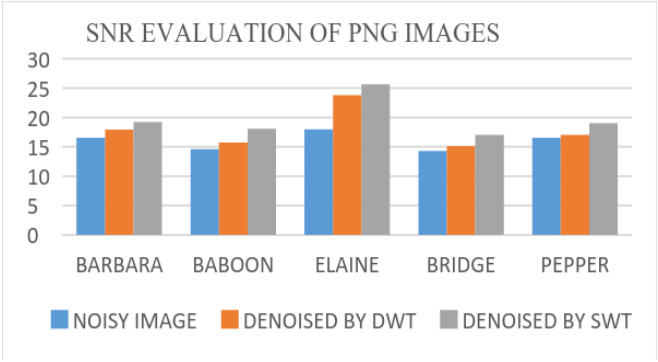
Table 5: SNR Values of PNG Format Images

DENOISED BY SWT	DENOISED BY DWT	NOISY IMAGE	IMAGES
16.88	15.11	14.13	BARBARA
18.44	16.03	15.85	BABOON
25.63	23.06	17.95	ELAINE
15.89	14.57	14.32	BRIDGE
23.11	21.09	15.88	PEPPER

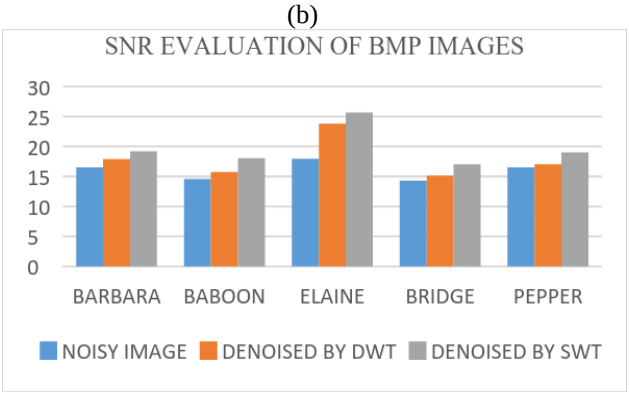
Table 6: SNR Values of BMP Format Images

DENOISED BY SWT	DENOISED BY DWT	NOISY IMAGE	IMAGES
18.55	17.55	16.54	BARBARA
18.22	16.91	15.85	BABOON
25.63	24.01	17.95	ELAINE
17.07	16.39	15.39	BRIDGE
22.86	21.02	15.87	PEPPER

(a)



(b)



(c)

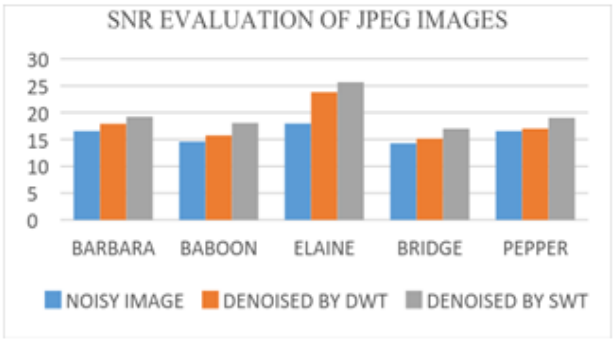


Figure 5: SNR values of Noisy Image, Denoised image using DWT Technique, Denoised image using SWT Technique (a)JPEG IMAGES (b) PNG IMAGES (c) BMP IMAGES

c. MSE Evaluation of Different Formats

Table 7: MSE Values of JPEG Format Images

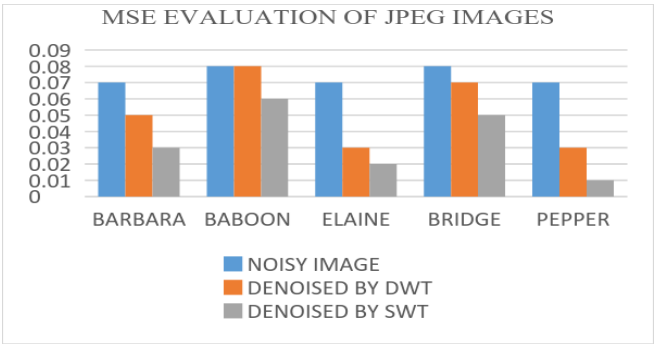
DENOISED BY SWT	DENOISED BY DWT	NOISY IMAGE	IMAGES
0.002	0.003	0.005	BARBARA
0.004	0.006	0.007	BABOON
0.0008	0.001	0.005	ELAINE
0.003	0.005	0.007	BRIDGE
0.002	0.003	0.005	PEPPER

Table 8: MSE Values of PNG Format Images

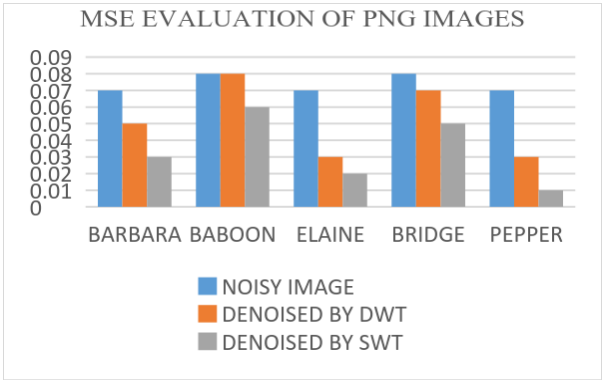
DENOISED BY SWT	DENOISED BY DWT	NOISY IMAGE	IMAGES
0.003	0.005	0.007	BARBARA
0.004	0.006	0.007	BABOON
0.0008	0.001	0.005	ELAINE
0.006	0.008	0.009	BRIDGE
0.0003	0.001	0.006	PEPPER

Table 9: MSE Values of BMP Format Images

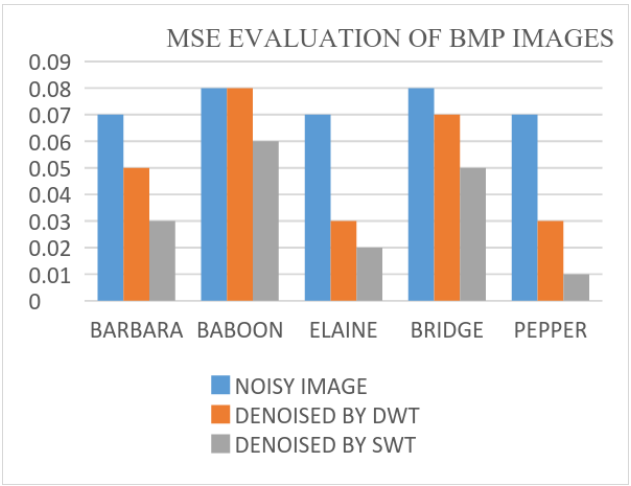
DENOISED BY SWT	DENOISED BY DWT	NOISY IMAGE	IMAGES
0.001	0.003	0.005	BARBARA
0.004	0.007	0.008	BABOON
0.0008	0.001	0.005	ELAINE
0.003	0.005	0.007	BRIDGE
0.0003	0.001	0.006	PEPPER



(a)



(b)



(c)

Figure 6: MSE values of Noisy Image, Denoised image using DWT Technique, Denoised image using SWT Technique (a)JPEG IMAGES (b) PNG IMAGES (c) BMP IMAGES

d. RMSE Evaluation Of Different Formats

Table 10: RMSE Values of JPEG Format Images

DENOISED BY SWT	DENOISED BY DWT	NOISY IMAGE	IMAGES
0.04	0.05	0.07	BARBARA

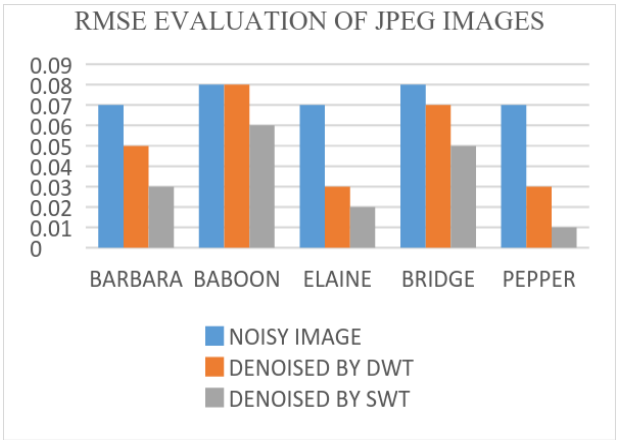
0.06	0.07	0.08	BABOON
0.02	0.03	0.07	ELAINE
0.05	0.07	0.08	BRIDGE
0.04	0.05	0.07	PEPPER

Table 11: RMSE Values of PNG Format Images

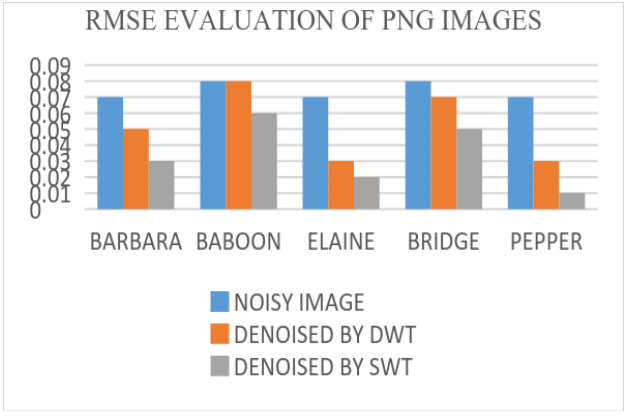
DENOISED BY SWT	DENOISED BY DWT	NOISY IMAGE	IMAGES
0.05	0.07	0.08	BARBARA
0.06	0.07	0.08	BABOON
0.02	0.03	0.07	ELAINE
0.07	0.08	0.09	BRIDGE
0.01	0.03	0.07	PEPPER

Table 12: RMSE Values of BMP Format Images

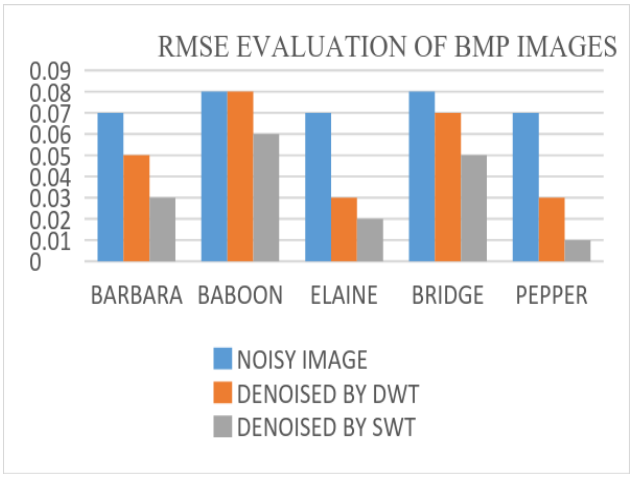
DENOISED BY SWT	DENOISED BY DWT	NOISY IMAGE	IMAGES
0.03	0.05	0.07	BARBARA
0.06	0.08	0.08	BABOON
0.02	0.03	0.07	ELAINE
0.05	0.07	0.08	BRIDGE
0.01	0.03	0.07	PEPPER



(a)



(b)



(c)

Figure 7: RMSE values of Noisy Image, Denoised image using DWT Technique, Denoised image using SWT Technique (a) JPEG IMAGES (b) PNG IMAGES (c) BMP IMAGES

C. Result Of Edge Detection

The Fig 4.3 shows the result of edge detection algorithm.

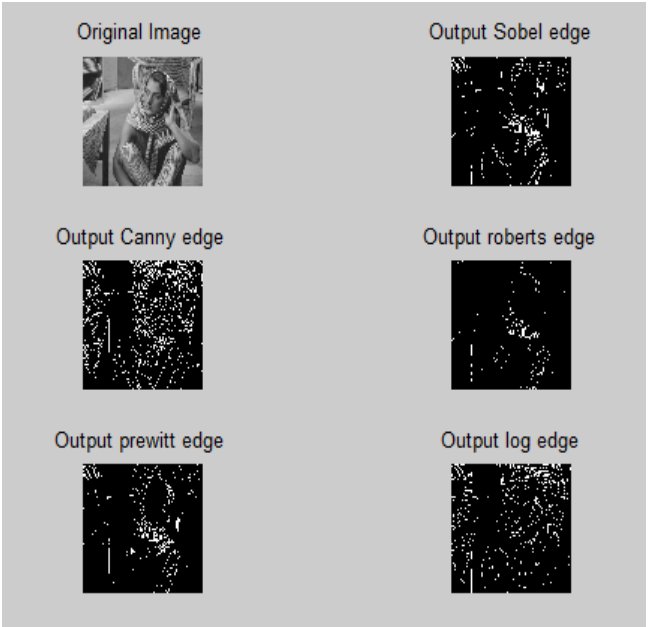


Figure 8: Results of image Edge Detection

D. Result Of Local Histogramm Equalization

The Fig 4.4 shows the result of use of local histogram equalization. The results show that the contrast of the image becomes better than the original image after apply the local histogram equalization technique. The Fig 4.4(b) shows the histogram of original and equalized image.

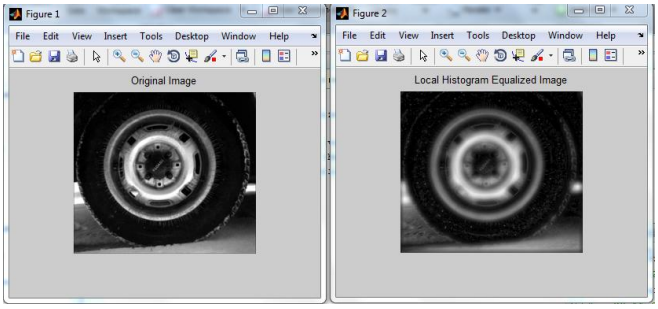


Fig 4.4 Results of Local Histogram Equalization (a) Original Image (b) Local Histogram Equalized Image

E. Result Of Singular Value Equalization

The Fig 4.5 shows results of Singular Value Equalization technique. Contrast of the image is improved after using SVE technique.

Fig 4.5 Results of Singular Value Equalization (a) Original Image (b) Image obtain using SVE Technique

CONCLUSION & FUTURE SCOPE

In this paper a comparative study of performance of Discrete Wavelet with the proposed SWT technique has been presented. The value of PSNR, SNR, MSE, RMSE parameters for DWT is compared with the proposed SWT. After implementation it has been found that the proposed technique provides better results than DWT technique. In this paper five images Barbara, Baboon, Elaine, Bridge, Pepper have considered in three different formats JPEG, PNG, BMP and result obtained by providing 8 db noise. The proposed technique gives better values of SNR, PSNR, MSE, and RMSE as compared to DWT. We have applied this technique on 2-D image so our work is on grey scale image. In future we can apply it on 3-D image to do work on coloured image. We can also apply this technique in specific field by adding more features in future.

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