

**Improve Method For Image Enhancement using DWT-CLAHE and
Combination Of Homomorphic Filter and Median Filter**¹Deepa Sahu, ²Anuj Bhargava, ³Prashant Badal¹Dept. of ECE, S.R.C.E.M College, Gwalior (India)²Dept. of ECE, S.R.C.E.M College, Gwalior (India)³Dept. of ECE, S.R.C.E.M College, Gwalior (India)

Abstract— In the research area related to images, Image enhancement (IE) is mostly used techniques. Image enhancement (IE) is done to upgrade the quality and visual appearance of an image. Almost all the pictures suffer from poor and bad contrast. In order to raise the quality of images we elevate the contrast and eliminate the noise. Image enhancement mechanism is of utmost important in medical sciences. Clear digital images are attained by image enhancement method. The enhancement mechanism varies from one range to another depending on its purpose. A novel algorithm for using color pictures is proposed. Since DWT is utilized in image compression and image compression reduces garage area, and set of rules is evolved to paintings directly in DWT area. DWT separates picture into high and low frequency additives. High frequency additives define assessment of an photograph. Here an enhancement method using DWT-CLAHE, homomorphic filter, sedian and HE Techniques is proposed. This uses advantages of the three transforms for image enhancement. Calculate the PSNR, NE, MAE, SSIM.

Keywords— Image Enhancement (IE), AHE, DWT-CLAHE, Homomorphic filter, Median filter.

I. INTRODUCTION

Digital image processing is the under digital signal processing which is dealing with the manipulation of the digital images by the use of digital computers[1] Digital image processing is better than analog image processing. It is done so that the images are interpreted easily by human eyes. It consists of many steps. The steps of IE are: Image Acquisition, Image Enhancement, Image Restoration, Color Image Processing, Wavelets & Multi choice Processing, Compression, Morphological Processing, Segmentation, Representation & Description, and Object Recognition. Image Enhancement is critical step. It is used to enhance the digital images. It is done for highlighting specific features of images. It is done to change low contrast images into high contrast images. Image enhancement differentiates the gadgets from the heritage. The histogram equalization (HE) could be very not unusual technique for image enhancement. Image enhancement is improving the visual pleasant of the picture [2].

II. USING TECHING**a. Discrete Wavelet Transform (DWT)**

It is a sampled wavelet function. The DWT that is primarily based totally on sub-band coding is discovered to yield a brief computation of Wavelet Transform (WT). It is straightforward to implement and decreases the computation time and sources required. Rather than calculate the wavelet coefficients at every factor, the DWT uses best a subset of positions and scales. These approach outcomes in an ideal and extra efficient way of a WT. The photograph is decomposed into four frequency bands and they're LL, LH, HL and HH.

b. Histogram Equalization (HE)

It is a procedure for adjusting photograph intensities to decorate assessment. It is a graphical illustration of the intensity distribution of a picture. It quantifies the quantity of pixels for every depth fee taken into consideration. It is a manner that improves the comparison in a photograph, so one can stretch out the depth range. Equalization implies mapping one distribution (the given histogram) to each different distribution (a miles broader and greater uniform distribution of depth values) so the intensity values are speeded over the entire variety.[3]

c. Adaptive Histogram Equalization:(AHE)

AHE is used for enhancing assessment in photos. It differs from HE with the aid of adaptive approach that computes several histograms and each histogram corresponding to a wonderful section of an photograph. The contrast of a area of an photo will no longer be sufficiently improved by means of HE. AHE get better this enhancement by approach of transforming each pixel with a change characteristic derived from neighboring vicinity. It is used to triumph over a few obstacles of world linear minima windowing method. Thus, it decreases the portion of noise in regions of the photograph. And also AHE have the potential of revamp the assessment of grayscale and coloration photograph.[3]

d. Contrast limited adaptive histogram equalisation-discrete wavelet transform(CLAHE-DWT)

As mentioned above, CLAHE is a conventional approach for enhancing the local assessment of an image, but it faces the over-enhancement and noise enhancement issues in some portions of the image. To conquer those problems, we suggest a unique photo enhancement technique, that is, CLAHE-DWT which mixes CLAHE with DWT. The approaches of the CLAHE-DWT set of rules are given as follows:

Step 1: Decompose the unique picture into low-frequency and

High-frequency components by using N-level DWT using Haar wavelet. The Haar wavelet is simple and hence appropriate for hardware implementation. The choice of parameter N is discussed in element later.

Step 2: Enhance the low-frequency coefficients the use of CLAHE and keep the high-frequency coefficients unchanged.

Step three: Reconstruct the photo by using inverse DWT of the brand new coefficients. Finally, take the weighted average of the reconstructed and unique images. The in the beginning proposed weighting coefficient makes the regions with distinct luminances better appropriately and thus alleviates over-enhancement correctly. [4]

e. Homomorphic filter based enhancement

It simultaneously normalizes the brightness at some point of an picture and increases comparison. Here homomorphic filtering (HF) is used to eliminate multiplicative noise. Illumination and reflectance aren't separable; but their approximate locations in the frequency location may be positioned. Since illumination and reflectance integrate multiplicatively, the additives are made additive by using taking the logarithm of the photo intensity, Just so those multiplicative additives of the picture may be separated linearly within the frequency region. Illumination versions can be notion of as a multiplicative noise, and can be decreased through manner of filtering in the log area. The HF is the satisfactory method to decorate the picture, due to its true control over additives, illumination-reflectance. [5].

f. Median Filtering (MF)

Median filtering follows this simple prescription. The MF is generally used to lessen noise in a photo, extremely just like the imply filter. However, it often does a better process than the imply filter of preserving useful element inside the photograph. This class of filter belongs to the magnificence of area keeping smoothing filters which might be non-linear filters. This approaches that for 2 photos $A(x)$ and $B(x)$:

$$\text{median}[A(x) + B(x)] \neq \text{median}[A(x)] + \text{median}[B(x)]$$

These filters smoothes the records even as maintaining the small and sharp info. Note that this isn't always similar to the common (or suggest); rather, the median has half of the values inside the neighborhood large and half smaller. The median is a more potent "valuable indicator" than the commonplace. In particular, the median is rarely affected by a small extensive sort of discrepant values maximum of the pixels inside the community. Consequently, MF could be very powerful at removing diverse varieties of noise.

III. LITERATURE REVIEW

Shilpa Suresh et al. [2017] In this paper, a robust and novel adaptive Cuckoo search based Enhancement algorithm is proposed for the enhancement of numerous satellite tv for pc pics. The proposed algorithm includes a chaotic initialization section, an adaptive Levy flight approach and a mutative randomization phase. Performance evaluation is done by way of quantitative and qualitative consequences contrast of the proposed algorithm with other cutting-edge metaheuristic algorithms. Box-and-whisker plots are also blanketed for comparing the stability and convergence

capability of all the algorithms examined. Test outcomes substantiate the efficiency and robustness of the proposed set of rules in improving a wide range of satellite tv for pc photos [6].

H. Kaplan et al. [2017] in this study, an enhancement method based on bilateral filtering is proposed. We propose to extract the details of the image by a multiscale bilateral filter and add these details to the original image using a weighting scheme. Visual results and evaluation metrics show that the proposed method, enhance the image better than the former methods while it better preserves the original color information [7].

Silviu-Ioan Bejinariu et al. [2017] in this paper an image contrast enhancement procedure based on multiobjective optimization is proposed. The contrast gain which has to be maximized and tone distortion which has to be minimized are used as optimization criteria. Because the histogram optimization is a high-dimensional problem, as optimization algorithm the usage of nature-inspired heuristics is proposed. Particularly, within the experiments supplied on this paper, the PSO set of rules is used. Our contrast enhancement method proves to be superior to traditional techniques like HE in terms of contrast gain and tone distortion, both criteria being optimized [8].

Su-Ling Lee et al. [2017] in this paper, a color image enhancement method is presented by using intensity histogram equalization (HE) approach without changing hue and saturation in HSI color space. The proposed method has better visual colorfulness than the conventional HE method because hue and saturation are preserved in the enhancement process. The back-lighting image and night-time image are used to demonstrate the effectiveness of the proposed color image enhancement method [9].

Bo-Hao et al. [2017] In this paper, our propose a new HE-based algorithm that enhances image contrast based on an assumption of maximum entropy to maintain other features of image quality. The experimental results verify that our proposed algorithm is optimal for generating enhanced images, according to both quantitative estimation and qualitative human visual inspection [10].

Zhou Zhao et al. [2017] In this paper our propose a new image contrast enhancement algorithm. It embeds PLIP operations right into a strong histogram amendment framework. Experimental effects show that the proposed set of rules can efficiently decorate image evaluation at the same time as stopping excessive enhancement [11].

IV. PROPOSED METHOD

Satellite images are low comparison and dark pictures, which has complete records but isn't visible. Similarly CT scans also are dark photographs. So the enhancement of such photographs will help to get greater facts. The hassle is how the contrast of an image can be improved from the enter satellite photos and CT snap shots. Here a brand new evaluation enhancement technique is proposed. There are 3 parts concerned. First one is dividing the picture into 4 blocks so that the operation can be finished on each block. Then DWT followed and Histogram Equalization. The result shows that images are visibly enhanced using DWT-CLAHE, homomorphic filter and median filter by incorporating local statistic method.

ALGORITHM-

The steps are as follows

1. Take an original image as a input.
2. Apply DWT on original image.
3. Take resultant image and decompose into LL LH HL and HH = DWT.
5. Apply DWT-CLAHE using LL band.
6. Apply Homomorphic Filter on image.
7. Apply Median filter on image.
10. Apply IDWT taking new original image.
11. Taking weighted average.
- 12 improve the contrast of image.
- 13 Calculate the PSNR, NE,MAE, SSIM.

FLOWCHART

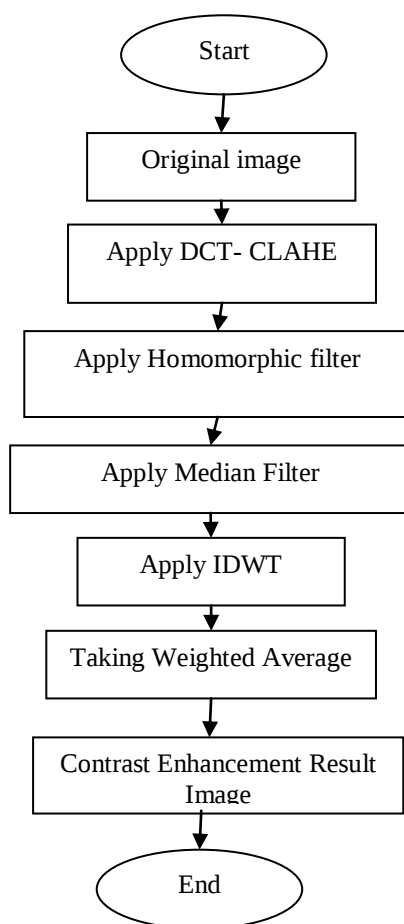


Fig. 1. Flow chart on Propose methodology

V. RESULT ANALYSIS

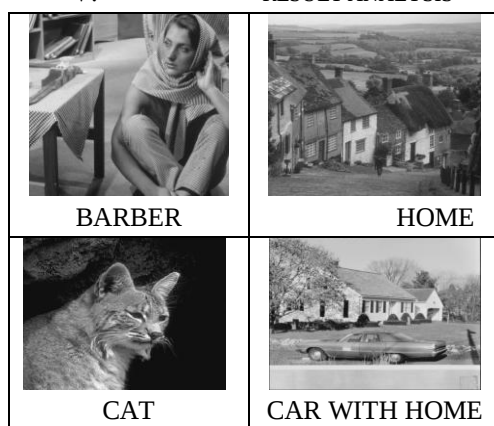


Fig. 2. Image Dataset



Fig. 3. Original image

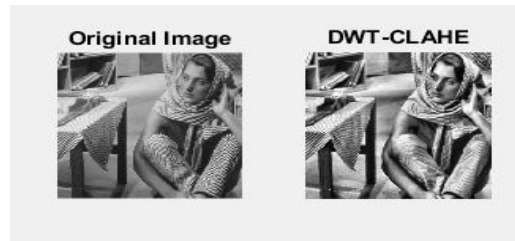


Fig. 4. Apply DWT-CLAHE on original image



Fig. 5. Apply the Homomorphic Filter image



Fig. 6. Median filter and Inverse image



Fig. 7. Taking weighted aberage image

Table 1 Base Parameter NE, PSNR, MAE, SSIM

Gray Image Name	NE (Noise Estimation)	PSNR (Peak Signal to Noise Ratio)	MAE (Mean Absolute Error)	SSIM (Structural Similarity index)
BARBER	10.5578	16.9489	8.8130	0.7232
HOME	6.7670	16.8318	5.4592	0.7147
CAT	7.3842	17.1512	4.0490	0.7732
HOME WITH CAR	6.7070	19.7318	13.0927	0.8131

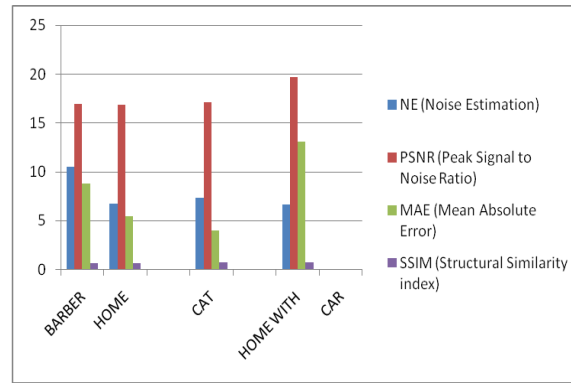


Fig. 8. Graph 1. Base Parameter NE, PSNR, MAE, SSIM

Table 1 Propose Parameter NE, PSNR, MAE, SSIM

Gray Image Name	NE (Noise Estimation)	PSNR (Peak Signal to Noise Ratio)	MAE (Mean Absolute Error)	SSIM (Structural Similarity index)
BARBER	4.9717	25.4326	3.2502	0.8146
HOME	3.4857	31.7065	2.0082	0.8606
CAT	3.0999	32.0594	1.6399	0.8904
HOME WITH CAR	2.0820	31.8050	1.5136	0.9194

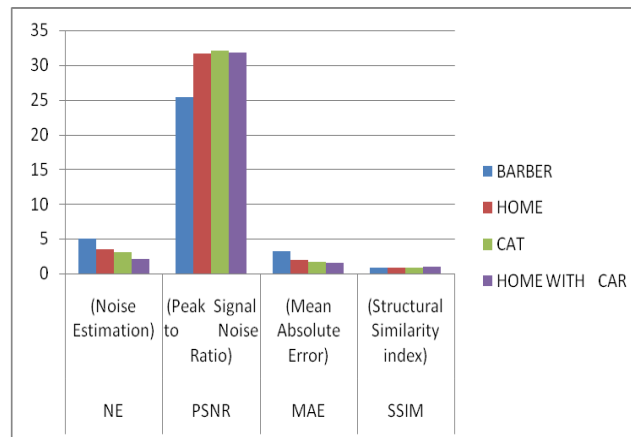


Fig. 9 Graph 2. Propose Parameter NE, PSNR, MAE, SSIM

conclusion

In this paper, we have discussed about the image enhancement techniques, Mainly Histogram Equalization and its changed approaches which includes Adaptive Histogram Equalization, Contrast Limited Adaptive Histogram Equalization, Exact Histogram Equalization with many extra methods to growth the efficiency. Image Enhancement approach is all approximately improving the visual appearance of images or we are able to say that photograph enhancement is upgrading the first-class of an image. There are several techniques for image enhancement but in this paper we describe about the enhancement method using DWT-CLAHE, homomorphic filter, median and HE Techniques is proposed. This uses advantages of the three transforms for image enhancement. Calculate the PSNR, NE, MAE, SSIM.

References

- [1] Anuradha Sharma, Namita Hindwani, Kuldeep Desai, Krishna Kumar Joshi, Sandeep Gupta, "A Review Paper on Various Digital Image Processing Techniques and Their Implementation Tool", IJSART - Volume 3 Issue 4 –APRIL 2017, ISSN [ONLINE]: 2395-1052
- [2] N. Mohanapriya,, B. Kalaavathi. "Comparative Study of Different Enhancement Techniques for Medical Images." International Journal of Computer Applications ,Volume 61, No. 20,2013.
- [3] Rupneet Kaur Hanspal, Kishor Sahoo, "A Survey of Image Enhancement Techniques". International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391, Volume 6 Issue 5, May 2017
- [4] Huang Lidong, Zhao Wei ✉, Wang Jun, Sun Zebin, "Combination of contrast limited adaptive histogram equalisation and discrete wavelet transform for image enhancement". IET Image Process., 2015, Vol. 9, Iss. 10, pp. 908–915 & The Institution of Engineering and Technology 2015. ISSN 1751-9659 Received on 16th June 2014 Accepted on 23rd April 2015
- [5] P. S. Vikhe, V. R. Thool, "Contrast Enhancement in Mammograms Using Homomorphic Filter Technique". January 2016 onference: International Conference on Signal Processing
- [6] Shilpa Suresh, Shyam Lal, Chintala Sudhakar Reddy, and Mustafa Servet Kiran" A Novel Adaptive Cuckoo Search Algorithm for Contrast Enhancement of Satellite Images" 1939-1404 © 2017 IEEE..
- [7] N. H. Kaplan, I. Erer vand N. Gulmus "Remote Sensing Image Enhancement via Bilateral Filtering"2017 IEEE.
- [8] Silviu-Ioan Bejinariu, Hariton Costin, Senior Member, IEEE, Florin Rotaru1 , Ramona Luca1 , Cristina Niță1 , Diana Costin3 "Image Enhancement by Multiobjective Optimization and Bio-inspired Heuristics" June 22-24, 2017 IEEE.
- [9] Su-Ling Lee and Chien-Cheng Tseng "Color Image Enhancement Using Histogram Equalization Method without Changing Hue and Saturation" 2017 IEEE International Conference on Consumer Electronics - Taiwan (ICCE-TW)
- [10] Bo-Hao Chen and Yu-Ling Wu "An Entropy-Preserving Histogram Modification Algorithm for Image Contrast Enhancement" Proceedings of the 2017 IEEE International Conference on Applied System Innovation IEEE-ICASI 2017.
- [11] Zhou Zhao, Yicong Zhou "An Image Contrast Enhancement Algorithm Using PLIP-based Histogram Modification" 978-1-5386-2201-8/17/\$31.00 ©2017 IEEE.