



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 9, September 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

 9940 572 462

 6381 907 438

 ijirset@gmail.com

 www.ijirset.com



Survey on Image Enhancement Techniques

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ABSTRACT: Image enhancement plays a crucial role, in image processing. Some images suffer from contrast visibility issues, low quality, and noise. By employing image enhancement techniques the quality of the image is improved and enhances its visibility. Various types of images are needed by applications nowadays as sources of information for interpretation and inspection. This paper presents a comparison of different methods that are used in image enhancement methods like Histogram equalization (HE), Dynamic Histogram Equalization (DHE), and a contrast enhancement algorithm using an exposure fusion framework applied to different images. The choice of a technique for image enhancement relies on the kind of application since it is crucial to remember that one technique does not work for all applications. Additionally, we evaluate the effectiveness of these image enhancement methods by measuring image quality metrics such as Peak-Signal-to-Noise Ratio (PSNR), Structural Similarity Index Measure (SSIM), Feature Similarity Index Measure (FSIM), and Mean Opinion Score (MOS) to determine the approach, for a given application.

KEYWORDS: Histogram Equalization (HE), Dynamic Histogram Equalization (DHE), Exposure Fusion Framework, Peak-Signal-to-Noise Ratio (PSNR), Structural Similarity Index Measure (SSIM), Feature Similarity Index Measure (FSIM) and Mean Opinion Score (MOS).

I. INTRODUCTION

Image is an important part of the life. It is very difficult to recognize and understand the environment without images. Images contain colors, details, and even other information. Images are typically divided into binary, grayscale, true color, and infrared categories. These images are then processed at various levels, including low level (noise removal, image sharpening, and contrast enhancement), mid-level (segmentation), and high level (analysis based on segmentation output [1]). Images may contain drawbacks like less detail, less lighting, and noise possess a defect that no one can comprehend easily. The modification, analysis, and transformation of digital images using diverse techniques, algorithms, and tools is referred to as image processing. The primary objective of image processing is to improve the quality of images, extract essential details, and enable more effective interpretation and analysis of visual data. In general, the main goal of image enhancement is to modify the original image so that it is used by specific applications.

It enhances image details such as edges, boundaries, or contrast to create a graphics display that is more useful for visualization and analysis [2]. While some of these approach extensive analysis of many image properties like edge, linked component information, and so on, others use straightforward linear or non-linear grey-level transformation algorithms. Numerous approaches for improving contrast have been proposed, including histogram-based and Retinex-based. The most straightforward method of contrast enhancement applies the same processing to every component [3], [4]. Histogram Equalization (HE) techniques enhance the contrast of the image. Numerous HE extensions that take into consideration of components like brightness preservation and contrast limiting have been presented.

However, HE-based approaches are prone to over-enhancement and provide unrealistic outcomes. Through the use of image enhancement techniques, we may change the image's elements to improve their sharpness, clarity, and details. Additionally, it seems to alter the graphical impression in a way that highlights the informational components of the image.

In essence, image enhancement is the first stage of image processing that strengthens edges and smooths out flat



portions of the image being processed to increase visual quality. This image enhancement has a variety of ways, including filtering methods, histogram methods, methods with several algorithms, and even a combination of various methods to provide great image restorations.

Image Enhancement can be categorized in the three ways [6], [7]:

1. Spatial domain method.
2. Frequency domain method
3. Hybrid Method
- 4.

Spatial Domain method

Image enhancement of the spatial domain is accomplished by modifying the image's pixel value, it is sometimes called as point processing. The assessment of night vision cameras has made image enhancement more difficult since it provides a picture with limited visibility and reduced contrast. This method produces an image that is more inline with how a person would interpret the scenes.

Frequency domain method

There are two kinds of frequencies in this method namely, High Frequency and Low Frequency. Sharper visuals can remove low frequencies while smoother images can do the same for high frequencies. It is also called as a Fourier transform high-pass and low-pass filter. The Fourier-converted image has different kinds of frequency domain procedures to alter its brightness, contrast, and distribution of grey levels, and eliminate impulsive noise. Low-frequency contents are removed to produce a sharper image, while high-frequency contents are removed to provide a more smoothed image.

Hybrid Method

A hybrid technique improves an image by altering its contrast by smoothing the contour information. It combines the benefits of both spatial and frequency domain enhancement approaches.

With this method, image details are enhanced using methods like Gaussian, and the image's contents are smoothed using Top-hat and Bottom-hat.

The rest of the paper is organized as follows, Section 2 explains Literature Survey. In Section 3, draws the conclusion and section 4 has the papers references.

II. LITERATURE SURVEY

Mohamad Nurfakhrian Aziz [1]

Proposed a paper on the "Implementation of Image Enhancement Techniques". This image enhancement is not only employed by us, but it is also applied in a variety of other sectors. Implementation in the military, medical sector, legal field, industry field, entertainment field, and many more areas. In each discipline, the basic purpose of picture enhancement is to gain clear information. Because this knowledge is really useful in everyday life.

This is also done to reduce misinterpretation of the information we get. We will cover surveys on the application of image improvements in certain fields, such as satellite photos, infrared images, medical images, and images for digital entertainment. In this work, as well as information from the image enhancing approach used.

Zhenqiang Ying [2]

Proposed a paper approach on a Contrast Enhancement Algorithm using an Exposure Fusion Framework to deliver accurate contrast enhancement. A weight matrix for picture fusion using illumination estimation techniques is designed. Then we present our camera response model. Combine images from many exposures.

Following that, we determine the appropriate exposure ratio such that the synthetic picture is well-exposed in the parts where the original photograph was underexposed, the input image, and the synthetic image are shown. To produce the enhancement result, the images are fused according to the weight matrix. Experiments demonstrate that our strategy may produce outcomes when compared to various state-of-the-art approaches, there is less contrast and brightness

distortion.

M. Abdullah-al-Wadud [3]

Proposed a paper approach on Dynamic Histogram Equalization (DHE) A smart contrast enhancement approach is suggested that is based on the usual histogram equalization (HE) algorithm. This Dynamic Histogram Equalization (DHE) technology takes control of the impact of classic HE, allowing it to improve an image without sacrificing details.

DHE divides the picture histogram into divisions based on local minima and assigns particular gray level ranges to each partition before equalizing it independently. These partitions are then subjected to a repartitioning test to confirm that there are no dominating sections. This method exceeds other current approaches by effectively increasing contrast without creating severe side effects such as washed out look, checkerboard effects, and other undesired artifacts.

Rati Geol [4]

Proposed a paper approach on implementation of Image Enhancement Techniques on Color n Gray Scale images, Today's applications demand numerous types of images as information sources for interpretation and inspection. Different techniques (equalization, contrast enhancement) are studied in this paper, since one approach does not work for all applications. There are several picture enhancing techniques are employed in this paper. Matlab is applied, test and validate the image's recommended solution strategies for improvement.

Shashi Rana [5]

Proposed a paper on "A review of Medical Image Enhancement Techniques for image Processing", Various sorts of photos, such as medical images, satellite images, aerial images, and real-lifephotographs, suffer from issues such as low contrast and noise. To improve image quality, it is critical to boost contrast and reduce noise.

A lot of effort has recently been done in the subject of image enhancement by many scholars and professionals. Many strategies for improving digital photographs have previously been proposed and developed. Most solutions are based on the notion of transform domain methods, which might generate artifacts that diminish the intensity of the input picture even further. The primary goal of this research is to expose the drawbacks of existing approaches.

Joany R.M [6]

Proposed a paper on "Image Enhancement by Histogram Equalization", Image enhancement is the practice of modifying digital pictures to make them appropriate for display or additional image analysis. Histogram equalization can be used to improve images. Histogram equalization is a technique for enhancing contrast by altering picture intensities.

This approach often boosts the overall contrast of a large number of photos. Especially when the image's useable data is represented by near-contrast values. As a result of this modification. The intensities on the histogram can be better spread. This enables areas with low local contrast to obtain a higher contrast. This is accomplished using histogram equalization, which effectively spreads out the most frequent intensity values.

Pankaj A. Mohrut [7]

proposed a paper on "Image Contrast Enhancement Techniques, A Report" , The primary goal of this topic is to give a better and higher-quality image by altering the quantity of saturation and lighting. This paper compares several popular image contrast enhancement algorithms that use histogram modification techniques, including histogram equalization, brightness preserving bi- histogram equalization, dualistic sub-image histogram equalization, recursive mean separate histogram equalization, dynamic histogram equalization, and enhancement using color and depth images. Histogram-based approaches primarily focus on equalizing the picture's histogram and enhancing the dynamic range associated with the image.

As a result of the considerable shift in brightness, such a picture has side effects such as washed- out look and false contouring. The image contrast enhancement algorithm overcomes the disadvantage of the histogram equalization approach. Using color and depth image histograms [9]. To address all of the aforementioned shortcomings, we presented a novel methodology termed image contrast augmentation utilizing joint segmentation.



Alain Horé [8]

In this paper, We examine two well-known objective image quality metrics, the peak-signal-to- noise ratio (PSNR) and the structural similarity index measure (SSIM), and derive a simple mathematical relationship between them that works for a variety of image degradations such as Gaussian blur, additive Gaussian white noise, jpeg, and jpeg2000 compression. A set of experiments carried out using photos retrieved from the Kodak database provides a clearer understanding of the similarities and differences between the SSIM and the PSNR.

Zhou Wang [9]

In this paper, an objective approach for evaluating perceptual picture quality has typically sought to quantify the visibility of faults (differences) between a distorted image and a reference image using a range of known human visual system attributes. We present an alternative supplementary approach for quality evaluation based on the deterioration of structural information, Assume that human visual perception is well adapted to extracting structural information from a scene.

Lin Zhang [10]

Proposed a paper on “FSIM:A Feature Similarity Index for Image Quality Assessment”, A unique FSIM for complete reference is presented in this research. IQA is presented on the basis that the human visual system (HVS) perceives a picture primarily based on its low-level properties. The fundamental characteristic of FSIM is phase congruency (PC), is a dimensionless assessment of therelevance of a local structure. Because PC is contrast invariant, yet contrast information affects HVS' impression of picture quality, the image gradient magnitude (GM) is used as a supplementary feature in FSIM. In describing image local quality, PC and GM perform complementary functions. After collecting the local quality map, we employ PC as a weighting function once more to calculate a single quality score. Tests are in six individual IQA databases to demonstrate that FSIM can have much higher consistency and we can extract features using FSIM in images which is useful.

TABLE 1: COMPARISON OF IMAGE ENHANCEMENT TECHNIQUES ON DIFFERENT PAPERS

Sl.no	Author	Title	Method used	Advantages
[1]	Mohamad Nurfakhrian Aziz,Tito Waluyo Purboyo	“A Survey on ImplementationOf Image Enhancement Techniques”	Spatial, Frequency, and Hybrid Method.	Understanding Image Enhancement and applications, different types of images like satellite images, Infraredimages andDigital images.
[2]	Zhenqiang Ying, Ge Li	“A new contrast Enhancement Algorithm using exposure fusion framework”	Contrast Enhancement Algorithm using Exposure Fusion Framework.	Combine multiple images with different exposure levels to produce an imagewith enhanced details, improved contrast,and reduced artifacts.
[3]	M.AbdullhAl Wadud,Md Hasanul Kabir	“Dynamic Histogram Equalization for Image Contrast Enhancement”	Dynamic Histogram Equalization(DHE)	Adaptive Contrast Enhancement, Preservation of Local Details Improved Visual Quality
[4]	Rati Geol, .Anmol Jain	“The Implementation ofImage Enhancement Techniques on Color and Grayscale Images”	Linear Contrast Stretching, Histogram Equalization H-, Adaptive H-EQ.	Improved Visualization of Local Features, Enhanced local details, Global Enhancement andenhanced visualization.



[5]	ShashiRana	“A Review of Medical Image Enhancement Techniques for Image Processing”	Histogram Equalization, Adaptive Histogram Equalization, and CLAHE	Enhanced details, improved visualization, Dynamic Range expansion, controlled enhancement and artifact reduction
[6]	JoanyR.M, Joseph Rathish	“Image Enhancement byHistogram Equalization”	Histogram Equalization	It is a most effective technique for grayscale images, adjusts the image intensity easily, and is used to reduce noise from an image easily.
[7]	Pankaj A. Mohrut, Dr.Deepthi Shrimankar	“Image Contrast Enhancement Techniques, A Report”	BBHE, DSIHE,RMSHE,MM BEBHE,DHE	Brightness is preserved, reduced over–enhancement,Enhanced Local Contrast,and reduced artifacts.
[8]	Alian Hore , DjemelZiou	“Image quality metrics: PSNR vs. SSIM”	Image Quality Metrics: PSNR and SSIM	PSNR is simple, widely recognized, and suitable for different applications, while SSIM takes into account human perception and is better at capturing local and structural differences.
[9]	Zhou Wang, Alan Conrad Bovik	“Image Quality Assessment: From Error Visibility to Structural Similarity”	Image QualityMetric: SSIM	Structural Information, Local and multiscale analysis, SSIM is known to be more robust to compression artifacts compared to traditional metrics like PSNR
[10]	Lin Zhang,Lei Zhang	“FSIM: A Feature Similarity Index for Image Quality Assessment”	Image QualityMetrics: FSIM	Useful in real-world applications, and multiscale Analysis and it considers bothlow-level and high-level structural information.

II. CONCLUSION

There are different kinds of images like satellite images, and medical images which require image enhancement techniques to be applied so that the quality of the image is improved, contrast and saturation are adjusted, and noise is eliminated to get a better and clearer image for further steps in image processing. Image Enhancement Techniques like Histogram equalization (HE), Dynamic Histogram Equalization (DHE), and Contrast Enhancement using an Exposure Fusion Framework are implemented and the performance of these methods is studied. Future research can focus on additional improvement and integration of all these strategies as technology advances, particularly in the field of artificial intelligence deep learning.

REFERENCES

1. Mohamad Nurfakhrian Aziz, Tito Waluyo Purboyo, Anggunmeka Luhur Prasasti, “ A Survey on Implementation Of Image Enhancement Techniques”, IJAER, Vol. 12, No. 21, pp. 11451- 11459, January 2017.
2. Zhenqiang Ying, Ge Li, Yurui Ren, Ronggang Wang and Wenmin Wang “A new contrast Enhancement Algorithm using exposure fusion framework”, Proc. of ICAIP, pp. 36-46, July 2017
3. M. Abdullah-Al- Wadud, Md. Hasanul Kabir, M. Ali Akbar Deewan and Oksam Chae, “Dynamic Histogram Equalization for Image Contrast Enhancement”, IEEE Tran. on Consumer Electronics, Vol.53, pp. 593-600, May 2007.
4. Rati Geol, and Anmol Jain, “The Implementation of Image Enhancement Techniques on Color and Grayscale Images”, 5th IEEE Conference on PDGC-2018, pp. 204-209, December 2018.
5. Shashi Rana, “A Review of Medical Image Enhancement Techniques for Image Processing”, IJCET, Vol. 5, No. 2, pp. 1282-1286, April 2015.



6. Joany R.M, Joseph Rathish, Susai Rajendran, “Image Enhancement by Histogram Equalization”,
7. IJNCSE, pp. 21-30, September 2015
8. Pankaj A. Mohrur, Dr.Deepthi Shrimankar, “Image Contrast Enhancement Techniques, AReport”, IRJET, Vol. 2, No. 02, pp.298-302, May 2015.
9. Alian Hore, Djemel Ziou, “Image quality metrics: PSNR vs. SSIM”, 20th IEEE International conference on pattern recognition, pp. 2366-2369, August 2010.
10. Zhou Wang, Alan Conrad Bovik, Hamid Rahim Sheikh, Eero P. Simoncelli, “Image Quality Assessment: From Error Visibility to Structural Similarity”, IEEE Transactions on Image Processing,
11. Vol. 13, No.4, pp. 600-612, April 2004
12. Lin Zhang, Lei Zhang, Xuanqin Mou, and David Zhang, “FSIM: A Feature Similarity Index for Image Quality Assessment”, IEEE Transactions on Image Processing, Vol. 20, No.8, pp. 2378-2386, August 2011.



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