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# A Unified Framework for Non Linear Image Enhancement via Histogram Specification for Optimizing Visual Quality of an Image

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**ABSTRACT:** Image enhancement with histogram specification is a digital image processing technique that is used to improve the visual quality of an image. In this approach, non-linear image enhancement methods are applied to transform the pixel values of an image, which results in an image with higher contrast, better brightness, and improved visual quality. The non-linear enhancement process is typically followed by a histogram specification step, which helps to adjust the overall brightness and contrast of the image to a desired level. Throughout the process, more or less image characteristics are modified. The choice of characteristics and the way they are altered are particular for a task. Generally, color images are represented in RGB color space. The RGB values of an image are converted into HSV values because HSV space is closer to human perception in which the (H) denotes to the spectral composition of color, saturation (S) defines the clarity of colors and (V) denotes the brightness of a color or just the luminance value of the color. The proposed method includes two processes, i.e. adaptive intensity enhancement and contrast enhancement. Adaptive intensity enhancement utilizes a particularly designed nonlinear transfer function which is capable of dropping the intensity of light areas and at the mean time enhancing the intensity of gloomy areas. Contrast enhancement adapts the intensity of every pixels magnitude based on its neighboring pixels. This dissertation has proposed a new hybrid method by combining non linear image improvement methods with dynamic restoration and has proved itself a far better technique in terms of Bit Error Rate, Mean Difference, Peak Signal to Noise Ratio and Mean Square Error.

## I. INTRODUCTION

### Image:

Images may be 2-Dimensional, such as a photographs taken by digital camera, screen display, and moreover, a 3-Dimensional, such as a figure. They may be taken by optical devices like lenses, microscopes, cameras, etc. and natural objects and phenomena, such as the human observer or water surfaces. The expression image is also used in the wider sense of any 2-D figure like, a map, a pie chart, or conceptual painting. In this broader sense, images can also be made manually, such as by drawing by using pencil or colors, painting, carving the statue or monument, made manually by printing using printer or computer graphics technology, or created by a grouping of methods.

### Image Enhancement:

Image enhancement [12] largely deals with the enhancement of images for viewing reason and thus provided that improved input for digital image processing methods. Throughout the process, more or less image characteristics are modified. The choice of characteristics and the way they are altered are particular for a task. Many observer factors, such as the human visual system and the observer's familiarity introduce an immense deal of subjectivity into the selection of image enhancement methods. There are numerous techniques that can enhance a digital image without damaging it. Image enhancement processes consist of a set of techniques that are use to improve the visual manifestation of an image or to translate the image for its analysis to be done by humans or digital device. Image enhancement deals with those image processing operations that enrich the quality of given image in order to overcome the limitation of the human visual system.



Fig1.3. (a). Before enhancement (b). After enhancement

## II. LITERATURE REVIEW

The objective of the literature review is to find and explore the benefits of image enhancement algorithms and also what are the different problems in existing algorithms and techniques.

**Kim et al. (2020)** [1] has discussed that the intensity of scene can be altered following the histogram equalization, which is because of the flattening attribute of the histogram equalization. KIM (1997) [6] proposed histogram equalization referred to as mean preserving bi-histogram equalization to conquer the disadvantage of the histogram equalization. The essence of the proposed algorithm is to conserve the mean intensity of an image while the contrast is enhanced. Given method initially break an input image into two sub-images based on the mean of the input image. One of the sub-images is the set of specimens that are less than or equal to the mean whereas the other one is the set of specimens greater than the mean.

**Tae et al (2019)** [2] has discussed a block-overlapped histogram equalization system for enhancing contrast of image sequences using various applications such as video door phone, security video cameras. The conventional histogram-based contrast enhancement technique is limited in real time application due to a large computational and storage requirements and it also exhibit quality degradation caused by possible loss of infrequently distributed pixel intensities, which may result in disastrous loss of important information.

**Yueet et al. (2021)** [3] has discussed a non-linear image enhancement method based on Gabor filters, which allows selective enhancement based on the contrast sensitivity function of the human visual system. The selective enhancement of the given approach is especially suitable for digital television applications to improve the perceived visual quality of the images due to various reasons, including interpolation.

## III. PROBLEM DEFINITION

The non-linear enhancement algorithm will use HSV plane to enhance the image, as it is known H and S component need no modification for enhancement so alteration will be done on V (intensity) only. The proposed method comprises two processes, i.e. adaptive intensity enhancement and contrast enhancement. Adaptive intensity enhancement utilizes a particularly designed nonlinear transfer function which is proficient of reducing the intensity of light regions and at the same time enhancing the intensity of gloomy regions. Contrast enhancement tunes the intensity of each pixels magnitude based on its nearby pixels. But it is also known that the enhancing the light or value component may not produce effective results in all the cases. Because change in brightness or light can only change the sharpness of the image. But it has not ability to modify the color strength which is also required in image enhancement. So to improve the non-linear image enhancement technique we will integrate non-linear image enhancement with the histogram specification. Histogram specification also adjusts the colors and saturation of the image so will produce better results. However as non-linear image enhancement has produced accurate results for intensity, so we will apply histogram specification only for H and S.

### 3.1 Objectives:

The main objective is to improve the result of the proposed algorithm over existing enhancement algorithms. To quantize the quality of proposed algorithm following sub-objective are selected.

1. The main objective of this work is to implement non-linear enhancement technique.

2. To improve the performance of non-linear color enhancement further a new integrated approach will be proposed which will integrate non-linear image enhancement with histogram specification on H and S component only.
3. To validate and verify the proposed algorithm different experiments will also be done by taking standard set of images.

#### IV. EXPERIMENTAL RESULTS

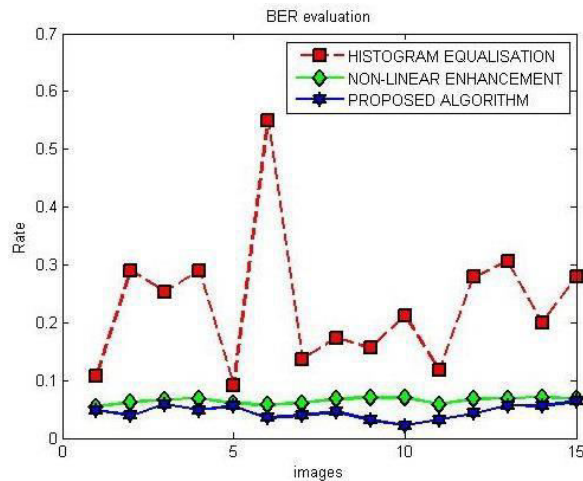


Fig 5.2.1 BER Evaluation

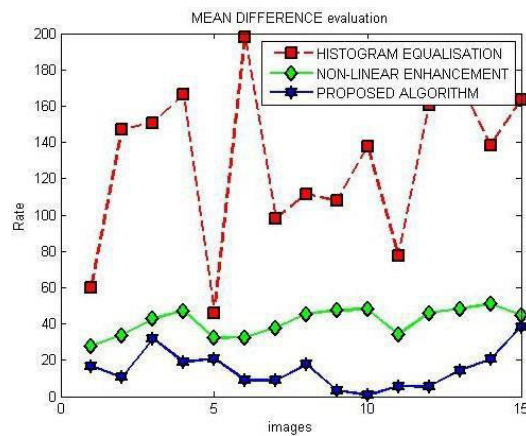


Fig 5.2.2 Mean Difference Evaluation

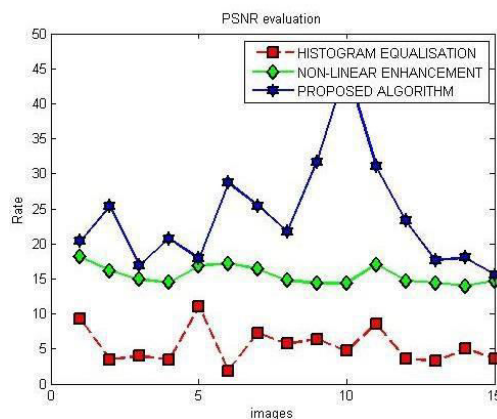


Fig 5.2.3 PSNR Evaluation

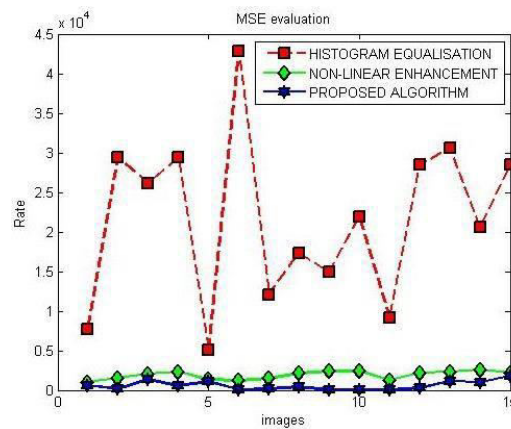


Table 5.2.4 MSE Table

## V. CONCLUSION AND FUTURE WORK

The image enhancements techniques play vital role in digital image processing. It is shown in this dissertation that the nonlinear image enhancement can be used to increase the quality of a blurred image by using the notion of the light source enhancement. This dissertation has focused on the various image enhancement techniques. Image enhancement has found to be one of the most significant vision applications because it has capability to improve the appearance of images. It enhances the perceivability of degraded images. Numerous procedures have been planned so far for enhancing the quality of the digital images. To increase an image quality image enhancement can particularly improve and limit some data presented in the input image. It is a type of visualization system which reductions image commotion, destroy antiquities, and maintain the informative parts. Its aim is to open up certain image characteristics for investigation, conclusion and future use. The main purpose of this dissertation is to discover the limitations of the all available image enhancement approaches. This work has proposed and combined improvement method to enhance the detailed variance in images. The solutions obtained from proposed method has been designed and implemented in MATLAB using image processing toolbox. Different images have been taken for experimental purpose and it is found that in most of cases the proposed algorithm provides quite enhanced results. The performance estimation has shown that the proposed method provides quite significant results over the available methods.

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