



## A Review of Various Image Enhancement and Noise Removal Methods

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**Abstract:** *Image enhancement is the method of applying certain modifications to an input image so that the resultant image is superior to the first image for a particular application or set of purposes. This paper presents a review of various enhancement techniques and noise removal methods for improving the contrast and visibility of images. Histogram Equalization and Median filtering is used to remove noise and increasing the contrast of degraded images.*

**Keywords:** *Degradation, Spatial domain, Histogram, Denoising, Enhancement.*

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### I. INTRODUCTION

Image Processing is a procedure in which digital images are handled by the method for digital computer. Its primary point is to enhance pictorial image quality for better human elucidation. Digital image processing is a wide subject and frequently includes methodology which can be complex; the major focus behind digital image processing is very straightforward. The definitive aim of image processing is to utilize information contained in the image that enables the system to comprehend, recognize and interpret the information accessible from the image design. Image processing can be classified into three levels: low, mid, high level processing. The term enhancement is subjective on that is enhancement for one individual can't be enhancements for other. The principle goal of enhancement is to handle an image such that the processed image is more suitable than the input image for user necessity. Now a day's these methods are pertinent in numerous regions like some of them are remote detecting innovation, remedial envisioning, biotech, environment science, face recognition, computer vision and so forth. The following image depicts degradation:



Fig. 1: Distorted Image

Image enhancement is the improvement of digital image quality without knowing the source of degradation and utilized to restore the pictures which have experienced some distortion. This alteration may be because of different reasons, e.g. optics, some electronic issue or some environment issues.



Fig. 2: Enhanced Image

Noise in images is available because of bit errors during transmission or affected during capturing stage. Salt and Pepper noise can degrade the images where the defiled pixel takes either greatest or least dim level. The expulsion of noise from the degraded image is known as Image Denoising. It's amongst the most well-known and imperative image processing operations in image and video processing applications. A proper image denoising model is ought to totally remove the noise and also protect edges.



Fig. 3: Image with salt & pepper noise

Linear filters are used to extract salt and pepper noise but degrade the image. In linear filtering, denoising procedures is directly applied to the images without checking the accessibility of noisy pixels. Thus it will also affect the non noisy pixels in the image. Non linear filters first detect out the noisy pixels and then filter the image. One of the majorly used techniques is non linear filtering for removing salt and pepper noise. The median filter is most popular non linear filter for removing impulse noise, because of its good denoising power and computational efficiency.



Fig. 4: Filtered Image

## II. LITERATURE REVIEW

[1] In this paper, a combined approach of both spatial domain as well as frequency domain techniques is described. From spatial domain log transform and power law transform are applied and from frequency domain alpha rooting algorithm is applied for contrast enhancement. Alpha rooting operates on transform domain and log transform and power law transform operate on pixels directly. This technique will produce highly balanced and contrast image. The disadvantage of this method is that it cannot properly enhance all part of image in same manner.

[2] Detailed review on various techniques of image enhancements are discussed in this paper, on basis of observation, point processing technique in spatial domain is most primitive one and used mostly for contrast enhancement. Image Negative is used for enhancing white regions embedded in dark regions and used in medical imaging. Power-law transformations are applicable in general purpose contrast manipulation. Log Transformation is useful for enhancing details in the darker regions of the image. The histogram of an image provides vital information of the contrast of an image.

[3] There are various image enhancement techniques for enhancing images, some of them are Contrast Stretching, Fuzzy grayscale enhancement, Fusion based approach on MSRRCR, A hybrid algorithm for spatial and frequency domain etc. It also provides a comparative analysis in tabular form. In fuzzy grayscale, enhancement technique only low contrast image are enhanced and required a certain processing time. In contrast stretching technique there is major disadvantage is that it require a lot of calculations. It is mainly used in medical image enhancement. This paper suggest that wavelet transform with retinex can be used to improve the image enhancement in the future.

[4] In this paper histogram based approach for image contrast enhancement is discussed. The differences between various histogram techniques are on criteria employed to divide the input histogram. The main difference between adaptive histogram equalization (AHE) and normal histogram equalization is that adaptive histogram equalization compute several histograms each for different section of image and use them to redistribute lightness of image. Brightness Preserving Bi-Histogram Equalization (BBHE) divides the whole image histogram into two parts. The resultant image is mean of the two. Histogram equalization provide better enhanced image than the other techniques such as point or neighborhood processing techniques.

[5] Contrast enhancement can be categorized into indirect and indirect method. Indirect method includes histogram equalization. It works by flattening the histogram and stretching the dynamic range of the gray levels using the cumulative density function. One disadvantage of the histogram equalization is that the brightness of an image is changed after the histogram equalization. To remove this we use Brightness Bi-Histogram Equalization (BBHE) and Dualistic Sub Image Histogram Equalization (DSIHE).

[6] The criteria of the noise removal problem depend upon the types of noise by which the image is degraded. This paper describe about various noise model and various filtering technique to remove noise from image to enhance the image. Filters techniques are divided into two parts linear and non-linear techniques.

[7] In image processing filters are mainly used to suppress either the high frequencies in the image, that are used to smoothen the image, or the low frequencies, that is enhancing or detecting edges in the image. There are basically three different kinds of filters: Low-pass filter, Median pass filter, High pass filter.

[8] Median filter algorithm which works on highly corrupted image with salt-and-pepper noise. First, all pixels into signal pixels and noisy pixels are classified using the Max-Min noise detector. The noisy pixels are then classified into various classes: low-density, moderate-density, and high-density noises. Finally the weighted 8-neighborhood function filter is applied to remove the noises for the low density  $5 \times 5$  median filter is applied to remove the noises for moderate density and the 4-neighborhood mean filter are adopted to remove the noises high level density.

[9] This paper introduces a survey on the current non-direct Median Filters for the evacuation of high thickness salt and pepper commotion. The fundamental nonlinear channel i.e. standard middle channel (MF) and distinctive variations, for example, versatile middle channels (AMF), and choice based middle channels (DBMF) shows better results at low and medium commotion densities. Adjusted Shear Sorting Method and Decision Based Unsymmetric Trimmed Median Filter (DBUTM) are utilized for evacuation of high thickness salt and pepper clamor in pictures and recordings, on the grounds that it has lower calculation time when contrasted with other standard calculations. Aftereffects of the calculation are contrasted and different existing calculations and this technique has better visual appearance and quantitative measures at higher commotion densities as high as 90%.

### III. IMAGE ENHANCEMENT AND NOISE REMOVAL

Image Enhancement converts low quality image into high quality images and filtering method id used to remove noise from degraded images. Both techniques are applied on degraded images for enhanced and filtered image. Histogram equalization is method of contrast adjustment using the image's histogram and applies histogram equalization on low contrast images. Here is the step by step procedure for enhancing the degraded image:

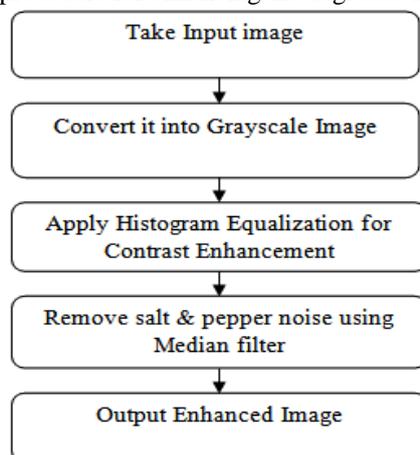


Fig 5: Stepwise procedure for Image Enhancement

Histogram equalization is a transformation in which contrast levels are being stretched by redistributing the gray-level values uniformly. In histogram equalization, we image contrast is increased by applying a gray level transform which tries to flatten the resulting histogram and output will be highly contrast image. After histogram equalization, salt and pepper noise is to be removed using inbuilt median filter in Matlab.

Image obtained after median filter is without salt and pepper noise and has more contrast than input image. Though this image is not very much enhanced but it can be useful. The following figure 6 depicts the input noisy and low contrast image and after applying histogram equalization and median filtering approach, the output image is shown in figure 7 which is filtered and highly enhanced image.



Fig. 6: Low contrast image with Noise



Fig. 7: Filtered image with high contrast

### IV. CONCLUSION

Image enhancement provides a variety of methods for modifying image to achieve visually acceptable image and are used to improve the visual appearance of an image or to convert the image to a form better suited for analysis by a human or machine. For example, to make an image lighter or darker, or to increase or decrease contrast or to remove noise from images. Noise hides the important details of images and degrades it. One the method used to enhance the image quality is

histogram equalization so as to improve the visibility of low contrast image. Also median filtering procedure is applied to remove salt & pepper noise from noisy images. Both procedures are implemented on various noisy and low contrast images to get enhanced and filtered images. Output images are much more enhanced than the input images. Huge amount of work has already been done by researchers in this field but a lot more has to be performed to improve the quality of images.

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