# A SELECTED REVIEW OF IMAGE ENHANCEMENT TECHNIQUES

**Kirti Agrawal[1],Priyanka Sharma[2],Miliind Deshkar[3]**

*Department of CEA GLA University, Mathura*

\*\*\*

*Abstract*—Image enhancement is a very foremost process to enhance the feature of an image, and we have studied various methods and applied to achieve this purpose. For getting an ideaof a modified efficient technique, this paper gives an overview ofvarious image enhancement processing techniques with the helpof which researcher can get idea for image enhancement. Different methods turned out to be used in numerous research papers. The prime issues in high quality images is image enhancement like camera. In vision applications also image enhancement plays a important role. The major objective of thispaper is to better understand together with review of diffrent methods used for image enhancement.

*Keywords— Image enhancement, Digital image processing , Frequency and Spatial Domain technique.*

\*\*\*

## I. INTRODUCTION

Image enhancement is the process to upgrade the information content and feature of authentic data prior to process. Enlarging the visual aspect of an image and to provide better transform representation for later computerized image processing are the main purpose of image enhancement .Numerous images suffer from noise and defective contrast such as medical images, aerial images, satellite images, and also real life pictures. For upgrading the evident presentation for an image, such as image purifying, image enhancement, image deblurring, image sharpening, image smoothing, there are different noise withdrawing techniques. This is one of the quickly developing technologies now a days, and its implementation is in numerous particular of a trade. The data's content is not increased by enhancement, but dynamic range of features are increased with the help of it which are selected to enhance in such a way that they can be easily recognized. Several degradations happens at the output if an image needs to transform from one shape to another shape like examining, transferring, storing etc.
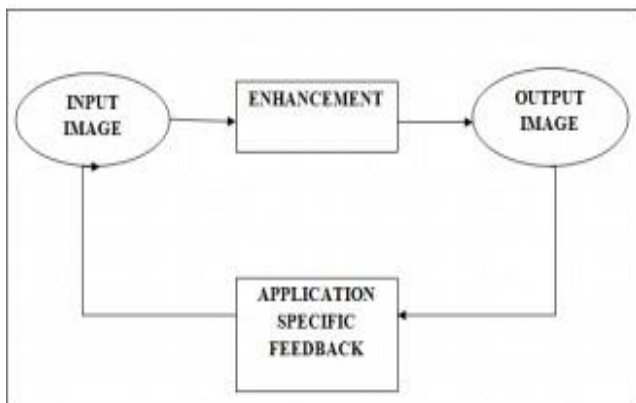


Fig. 1 Image Enhancing Method

## II. CLASSIFICATION OF IMAGE ENHANCEMENT TECHNIQUES

There are numerous techniques that are used for image enhancement are given below-

1. Spatial Domain Technique
2. Frequency Domain Technique

### 2.1. *Spatial Domain Technique*

In spatial domain technique, we trade in image pixels directly. To achieve required enhancement, the pixel values are manipulated .This technique is to change the image representation and utilized in various fields like smoothing and sharpening. This technique advantage is that it is not typical to acknowledge and for this technique the complexity is very less that assists in application of simultaneous implementation domain property. This technique does not come up with sufficient comprehensible and robustness. It is main drawback of this technique. It alters the individualpixels gray level value and therefore the comprehensive contrast for the complete image [9].
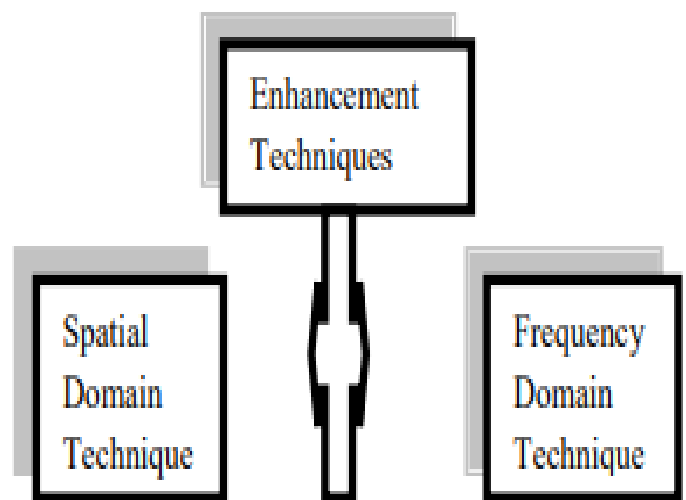


Fig. 2. Types of enhancement techniques

Spatial domain technique for image enhancement is categorized in two parts-
1. Global Image Enhancement
2. Local Image Enhancement

These methods require primarily histogrammodification that make use of complete variation range for areproducing apparatus after changing image histogram. These methods are very simple and need small computational endeavour and this is main attractiveness of this method. Nevertheless to enhance detail over a smaller region, it is frequently mandatory. So, there is a major role oflocal image enhancement method in these applications. Various spatial domain methods are splited accordingly in local or global image enhancement.

### 2.1.1 Histogram Equalization

By using Histogram equalization technique we increase dynamic range of image histogram. The pixel intensity value is assigned in the input image so that there is a consistent distribution of intensities in the output image. Its property is to adjust image global contrast. For gray scale images this is the very productive method.

### 2.1.2. Adaptive histogram Equalization

By altering intensity image values ,it enhances disparity of images .It needs to be operated on little data regions (tiles) unlike HE, instead of complete image. This is the addition of HE and for local enhancement in an image it is used. Dark region and low contrast is contained within it.

### 2.1.3. Bi-histogram Equalization

Histogram is splited in bipartite by BHE according to the mean where it lies. Then we need to enhance each part using HE without depending on each other. The original image Intensity mean is maintained with the help of which it beats the excessive enhancement problem.

### 2.1.4. Laplacian

Laplacian is edge enhancing algorithm by which the edges of an image is enhanced in the same way. The brightness levels of image pixels are enhanced locally by using Laplacian.

### 2.2 .Frequency Domain Technique

This technique represents the transfer of image in frequency domain that means we first calculate Fourier Transform for an image. It perform purely with convolution theorem to change the image position. This technique advantage is minimum computation complexity manipulation of frequency composition of image, easy to visualise, and its easy to apply the particular altered domain property.

Convolution theorem is base of frequency domain techniques. Examine succeeding spatial domain operation:
$$g(x,y)=h(x,y)*f(x,y)$$
The convolution theorem gives relation by making use of frequency domain that is given below-

$$G (u,v) = H(u,v) F(U,v)$$

Here G, H and F represent the fourier transform of g, h and f respectively. The process transfer function is H. With the help of above equation numerous image enhancement problems can be noticed.
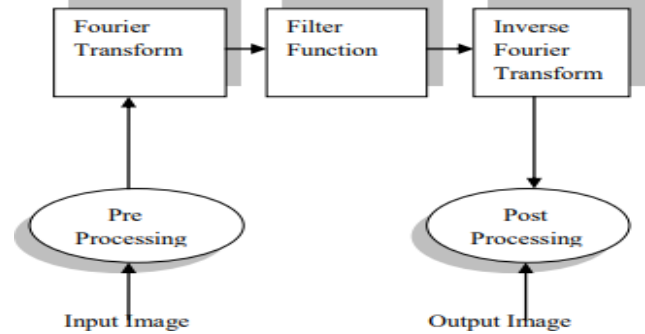


Fig. 3. Enhancement Process

The main filters are of three types -
1. Low pass filter
2. High pass filter
3. Band pass filter

### 2.2.1. Low pass filter

Transitions and edges are sharpened by low-pass filtering of an image in its gray levels. It gives contribution significantly to the Fourier Transform of high frequency content.

### 2.2.2 High-pass filter

To achieve Image sharpening in frequency domain, Low frequency part is reduced with the help of high pass filter without disordering information of high frequency.

### 2.2.3. Band-pass filter

In this method we can filter illumination as well as reflectance components without depending on each other.

Table1. Techniques where they are applied including their area

| Techniques | Characterstics |
|---|---|
| Spatial Domain Technique | For altering the gray level value of discrete pixels, it is used and therefore the general contrast of the whole image. It is impossible to enhance borderlines selectively or many other essential facts effeciently. |
| Frequency DomainTechnique | For enhancing edges and many other useful details, it is used because of its excessive frequency content and frequency domain controls image frequency content. Full portion of an image neednot to be enhanced in consistent manner in this technique. |

## I.AREAS OF IMAGE ENHANCEMENT APPLICATION

The areas where image enhancement is widely used are:

### A.Atmospheric sciences

Image enhancement can lessen the effects of mist, fog, or stormy climate for meteorological inspections. It assists in identifying figure as well as remote objects structure in environment discern. Satellite images go through image enhancement as well as restoration for removing noise.

### B.Forensics

For identification, observance and evidence collection we use image enhancement. The acquired images of fingerprint erception, security recordings scanning and crime site explorations are enhanced for spotting criminals and victims defense.

### A. Astrophotography

Because of noise and light pollution ,it faces challenges which needs to be reduced by image enhancement. A great many cameras have essential IE functions for instantaneous contrast enhancement and sharpening. Numerous softwares give permission to modify these images to provide better results.

### B. Geoscience

It includes the analysis of various images to acknowledge fascinating attributes sediment concentration and bathymetric patterns, water flow. All the previously mentioned characterstics are directly visible in images to lessen the difficulty of moving targets, deficiency of light that need to be enhanced digitally.

The other areas of image applications are like law enforcement, biomedicine, bacteriology, microbiology.

Fig.4 Enhanced Example

## IV.LITERATURE SURVEY

This paper introduce the research work of some important writers of similar field and demonstrate a brief description of diffrent methods that are used mainly for Image Enhancement.

*A.* Komal R. et al. [1] proposed an algorithm that is canonical genetic algorithm together with reviewing of image pre-processing work. Genetic algorithm is the unbiased optimization technique to perform vigorous search in local extremes without trapping . This paper incorporate the description of image segmentation and image enhancement by using Genetic Algorithm.

Samantaray, et al. [2] focused to improve fingerprints byusing Gaussian method framework proposed difference which refine confined contrast, and confined edge information by decomposing input image into many band-pass images. On low quality output contrast and fingerprints, the suggested fingerprint enhancement method works efficiently unexpectedly .For that, histogram equalization is used C Chengtao Cai, et al. [3] proposed an effective method todeblur image based on sound suppression as well as edge enhancement that is called as blind deconvolution. For suppressing noise in dull edge part, there is a need of trilateral filter method. At last, at image recovery phase, thereis an implementation of non-blind deconvolution.

*D.* Yaping, et al. [4] proposed refinement method stepwise. This method main objective is to identify and enhance specific part of a digital image, and support other object information without altering it. That's why to solve the issue that contain image pre-processing, identification and enhancement uses gradual refinement method.

*E.* Zhe Liu, et al. [5] proposed a CNN model for image denoising in deep learning. The main benefit of employing CNN model is that this model parameters can be advanced by using network training; while these algorithms parameter are fixed in conventional image denoising and during filtering these are not adjustable that is absense of adaptivity.

*F.* M.S. Imtiaz,et al. [6] proposed a method for improving anomalies the detection rate that exist in GI images using adaptable endoscopic image enhancement as well as color reproduction. To colorize grayscale narrow band images (NBI) and video frames this technique is used The technique is also used. It is demonstrated by the color similarity test that suggested technique do not attach somewhat supplementary shade that are not available in the initial pictures.

*G.* Puspad Kumar, et al .[7] proposed the CNN with edge adjustment . Here the design of less light image enhancement technique is focused mainly.This developed technique has greatly advantages in comparison to other existing methods.There are many applications like geo- satellite images ,remote sensing applications, etc in which enhanced image is used for future work.

*H.* Xiaoying Fang et al. [8] suggested a method called image fusion method for improving the enhancement result with assessment on sharpness. The discrimination of facts can be increased by image enhancement. First we take an image from a real site then we divide it into some area depending on the need of enhancement. The experiment results reveal that the fusion increases the enhancement outcome.

*I.* Nishant Bhardwaj et al. [10],proposed histogram equalization based on learning ensemble for image contrast enhancement. Zhenzhou An et al. [11] proposed image enhancement and denoising through graph-based viewpoint. The color image denoising and enhancement is achieved by learning of graph-based dictionary that is acquired with the help of nonlocal alike patches of every color channel and by the use of graph-based sharpening filter, image is enhanced [12].

.V. ILLUSTRATION OF ENHANCED IMAGES
When we apply histogram equalization on the low contrast
input image, then enhanced image is resulted. Fig. 5 shows the resulted enhanced image after performing histogram equalization as given below. There are some other illustrations to show Image Enhancement as shown in Fig. 6 and Fig. 7



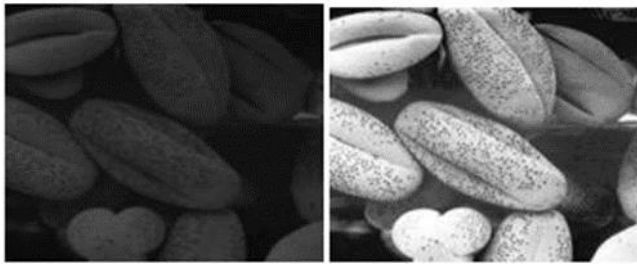Fig 6: Enhanced Output Image after Salt-and-pepper Noiseremoval



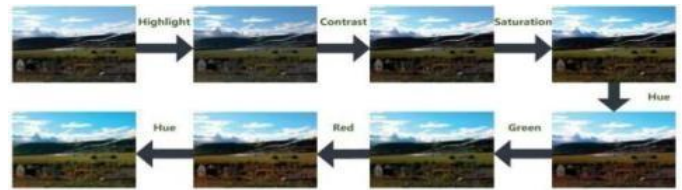Fig 5: Histogram-Based Technique of Contrast Enhancement



Fig 7: Machine Learning based Image Enhancement

Illustrations show that the when we advance the techniques from filters to the usage of CNN then there is a thorough improvement in the enhancement of color images with respect to HSI.

V. RESULTS ANALYSIS
We have examined diffrent image enhancement techniques and exposed various parameters that indicate quality of enhanced images by contrast and noise density which are acquired by techniques of image enhancement after comparing to original image.The Comparison between different images Enhancement techniques result is shown below in the form of table

Table 2. Differentiation between distinct image Enhancement methods

| S.No. | Paper Title | Writer Name | Method used | Benefits | Shortcomings |
|---|---|---|---|---|---|
| 1 | Application of Genetic Algorithm for Image Enhancement and Segmentation | Komal R. Hole, Prof. Vijay S. Gulhane, Prof. Nitin D. Shellokar | Genetic Algorithm | Image with outstanding and logical contrast. | Result is dependent on the chromosome encoding scheme |
| 2 | An efficient DoG based fingerprint enhancement scheme | Samantaray, S., Bakshi, S., Sa, P.K | Laplacian pyramid framework | Provides strong result even on low quality fingerprints images. | Noisy image due to defective scanning method |

| 3 | Blind Deconvolution for Image Deblurring Based on Edge Enhancement and Noise Suppression | Chengtao Cai, Haiyang Meng , And Qidan Zhu | blind deconvolution | Robust method for crushing noise and enhancing edge information. | Difficulty in dealing with blurry image that are blurred or twisted by water waves |
| --- | --- | --- | --- | --- | --- |
| 4 | The recognition and enhancement of traffic sign for the computer-generated image | Yaping, L., Jinfang, Z., Fanjiang, | Red light camera technology | Remove unwanted objects, adjust exposure, saturation, sharpness | accurately identify specific target while maintaining other information of object |
| 5 | Image Denoising Based on a CNN Model | Zhe Liu, Wei Qi Yan, and Mee Loong Yang | CNN Model | For removing guassian noise and pepper noise, it provides robust performance | No better filtering results Because of less upgradation of CNN model. |
| 6 | NEW COLOR IMAGE ENHANCEMENT METHOD FOR ENDOSCOPIC IMAGES USING ADAPTIVE SIGMOID FUNCTION AND SPACE VARIANT COLOR REPRODUCTION | Imtiaz, M.S., Khan, T.H., Wahid | ADAPTIVE SIGMOID FUNCTION | Low complexity with high execution speed | Noise is enhanced in smooth regions |
| 7 | Edge Enhancement from Low-Light Image by Convolutional Neural Network and Sigmoid Function | Puspad Kumar, Nitesh Gupta, Anurag Shrivastava | Convolution Neural Network accompanied by edge adjustment | For high quality enhancement, Less contrast images are flexible | Poor illumination, atmospheric condition, noise affects the quality |
| 8 | A Method to Improve the Image Enhancement Result based on Image Fusion | X. Fang, J. Liu, W. Gu and Y. Tang | Image Fusion | blends image according to the sharpness | ---------------- |

## CONCLUSION AND FUTURE SCOPE

Image enhancement algorithm provides a comprehensive variety of approaches to give a superior view for enhancing or changing diffrent images . Enhancement techniques make familiar with the enhancement of a blurred image, noise removal, setting the brightness, contrast and various other degradations in the image processing These techniques help researchers to diffrentiate various enhancement algorithms to opt finest according to requirement. This survey provides total information about the various image enhancement techniques and their associated method. And we have also discussed their advantages and disadvantages.

## REFERENCES

[1] Komal R. Hole, Vijay S. Gulhane, Nitin D. Shellokar, "Applications of Genetic Algorithm for Image Enhancement and Segmentation", IJARCET, vol.2, issue. 4, April 2013.

[2] Samantaray, S., Bakshi, S., Sa, P.K.: An efficient DoG based fingerprint enhancement scheme, published in Proceedings of the International Conference on Advances in Computing, Communications and Informatics, pp. 547–550. ACM.

[3] Blind Deconvolution for Image Deblurring Based on Edge Enhancement and Noise Suppression, , October 3 2018.

[4] Yaping, L., Jinfang, Z., Fanjiang, X., Xv., S.: The recognition and enhancement of traffic sign for the computer-generated image, published in Fourth International Conference on Digital Home (ICDH), pp. 405–410, 2012.

[5] Zhe Liu, Wei Qi Yan, and Mee Loong Yang Image Denoising Based on a CNN Model in Intern. Conf. on Control, Automation and Robotics 2018.

[6] Imtiaz, M.S., Khan, T.H., Wahid, K.: Color Enhancement in Endoscopic Images Using Adaptive Sigmoid Function and Space Variant Color Reproduction, 2014.

[7] Puspad Kumar, Nitesh Gupta, Anurag Shrivastava Edge Enhancement from Low-,Light Image by Convolutional Neural Network and Sigmoid Function, VOLUME. 7, ISSUE 1, FEBRUARY 2020.

[8] X. Fang, J. Liu, W. Gu and Y. Tang, "A Method to Improve the Image Enhancement Result based on Image Fusion," 2012.

[9] Arun R, Madhu S. Nair, Member, IAENG, R. Vrinthavani and Rao Tatavarti, "An Alpha Rooting Based Hybrid Technique For Image Enhancement", Engineering Letters, 19:3,EL_19_3_03.

[10] .Nishant Bhardwaj, Gagandeep Kaur and Pradeep Kumar Singh:" A Systematic Review on Image Enhancement Techniques"2018.

[11] Xiaoyan Wang, Zhenzhou An, Haifeng Wang, and Yuchou chang MR Brain Image Enhancement Via Learning Ensemble proc.IEEE Intern. Conf. on Intellegence & safety for Robotics,2018.

[12] H.Sadreazami, A. Asif, A. Mohammadi Data-adaptive color Image Denoising and Enhancement Using Graph-based Filtering IEEE 2017.

[13] Bangzhong Gu, Bin Chou, Limin Luo Retinal Vessel Enhancement Via Sparse Coding and Dictionary Learning Intern. Conf. on MVA 2017.

[14] Saurabh B. Lakade and Dr. S.K Shah Single Image Resolution Enhancement by Patch based Learning IEEE 2017.

[15] Juhwan Kim, Seokyong Song and Son-Cheol Yu Denoising Auto- Encoder Based Image Enhancement for High Resolution Sonar Image IEEE 2017.