ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 7, July 2014

A Review on Underwater image enhancement

Varinderjit kaur[1], Arpinder Singh[2] and Ajay Kumar Dogra[3]

CSE, BCET, Gurdaspur, India[1]

Associate professor, CSE, BCET, Gurdaspur, India[2]

Assistant professor, CSE, BCET, Gurdaspur, India[3]

Abstract: Image enhancement technique is one of the widely used techniques to improve the image quality by enhancing the visibility of the images. This paper presents several image enhancement techniques. These techniques have been developed in a number of applications such as underwater images, medical images etc. Due to light absorption, light reflection, bending of light and scattering of light or poor visibility of underwater images, there is need to improve the quality of an underwater image. This paper ends with the certain limitations of existing techniques.

Keywords: Gabor filter, histogram stretching, dark channel prior, adaptive gamma correction.

I. INTRODUCTION

Image enhancement is a process of changing an image so that the result is more suitable than the original for a particular application. Image enhancement commonly used in computer graphics and it is the sub area of image processing. Various enhancement schemes are used for enhancing an image which includes gray scale manipulation, Histogram equalization and filtering. Image enhancement techniques can be divided into two broad categories: Spatial domain methods and Frequency domain methods. Spatial domain is the collection of pixels composing an image. Spatial domain techniques are procedures that work directly on these pixels. In spatial domain, an integrated neighborhood dependent approach for nonlinear enhancement is put on the gray component of the original color image and get enhanced color image by linear color restoration process. Spatial domain processes is denoted by the expression such as g(x, y) =T [f(x, y)]. Point processing is the process of contrast enhancement. This process produces an image of higher contrast than the one by darkening a particular level. Enhancement at any point in an image depends only on the gray level at that point techniques in this category are often called point processing.

Histogram equalization has the most important role in any image processing which is used on a whole image or just on a part of an image. HE is a popular technique for contrast enhancement due to simplicity and effectiveness. Mainly, it is used to remap the gray levels of an image based on the image's gray levels cumulative density function. It compresses and stretches the dynamic range of the output image histogram and it also enhances the contrast of the image and gives an overall contrast improvement. HE changes the brightness of a produced image and becomes saturated with very bright or dark intensity values. This technique is commonly used in the field of sonar image processing, consumer electronics, radar image processing, medical image processing, image matching and searching, speech recognition and texture synthesis because of high efficiency and simplicity. However, sometimes it also sinks the result which is often called as washed out effect. Frequency domain is used the Fourier transform of the image to be enhanced, multiply the result by a filter, and take the inverse transform to produce the enhanced image. The transform domain methods first transform the gray level image into the frequency domain by using the Cosine, Fourier, or Wavelet transforms and then modify the transform domain coefficients.

II. IMAGE ENHANCEMENT TECHNIQUE

A. NON-LINEAR IMAGE ENHANCEMENT TECHNIQUES

Non-linear enhancement is a technique whose output is not a linear function of its input. That is, if this technique gives output intensity *R* and *S* for two input pixels *r* and *s* individually, but does not always output $\alpha R + \beta S$ when the input is a linear combination $\alpha r + \beta s$. There are some basic drawbacks of the transform-based image enhancement methods such as they introduce certain artefact and cannot concurrently enhance all parts of the image very well and it is difficult to automate the image enhancement procedure. So to overcome this problem the luminance and contrast enhancement of V component of the input image has been described. The shape of the nonlinear transfer function for luminance enhancement remains same for all the pixels, but the illumination on the all regions of the image has not been same, some regions may be dark and some may be bright. So while enhancement of the color image, locality has to be considered. In order to achieve this goal firstly the value component image in HSV image space has been divided into smaller overlapping blocks. In contrast enhancement process, for each pixel the amount of enhancement has been calculated depending upon the center pixel itself and its surrounding pixel values. Fig. 1 shows the block diagram of the proposed method. In general, color images are represented in RGB color space. HSV space is closer to human perception in which the (H) refers to the spectral composition of color, saturation (S) defines the purity of colors and (V) refers the brightness of a color or just the luminance value of the color.

$$V_{le} = \frac{V^{(0.75x+0.25)} + 0.4(1-x)(1-V) + V(1-x)}{2}$$

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 7, July 2014

The RGB values of an image are converted into HSV values. The luminance enhancement is the first step for enhancing the images captured under low or non-uniform illumination conditions, which has been applied to the V component of the input image using specially designed non-linear transfer function. The Luminance enhancement is also known as process of dynamic range compression. The V channel image has been subjected for luminance enhancement. Suppose VLE be the transferred value by applying non-linear transfer function defined below.

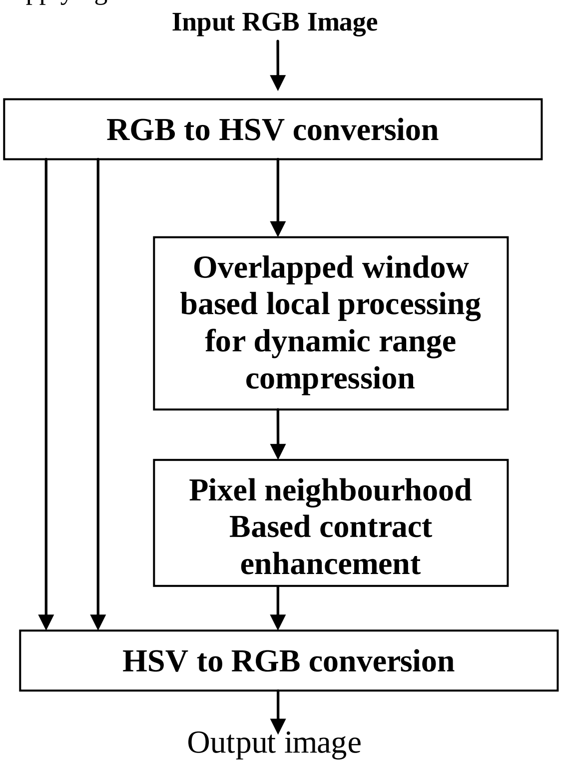


Fig 1. Block diagram of non-linear technique

Nonlinear contrast enhancement often involves histogram equalizations through the use of an algorithm. The nonlinear contrast stretch method has one major disadvantage. Each value in the input image can have several values in the output image, so that objects in the original scene lose their correct relative brightness value. There are two methods of nonlinear contrast Enhancement.

1. Histogram Equalizations
2. Adaptive Histogram Equalization

A. Histogram equalization

Histogram equalization (HE) is popular method of contrast adjustment using the image's histogram and also enhances a given image. In this method, transformation *T* is to be designed in such a way that the gray value in the output is equally distributed in [0, 1]. It is also called histogram flattening. Histogram equalization method in which histogram is modified by spreading the gray level areas. When an image's histogram is made equal, all pixel values of the image are redistributed so there are approximately an equal number of pixels to each of the user-specified output gray-scale classes e.g., 32, 64, and 256. Contrast is increased at the most populated range of brightness values of the histogram. For very bright or dark parts of the image, It automatically reduces the contrast associated with the ends of a normally distributed histogram. It can also divide pixels into different groups, if few output values are over a wide range. But this method is effective only when the original image has poor contrast to start with, otherwise it may degrade the image quality.

(a)

(b)

Fig 2. (a)Original image (b) histogram equalization based image

Consider a discrete grayscale image $\{x\}$ and let n_i be the number of occurrences of gray level i. The probability of an occurrence of a pixel of level i in the image is

$$p_x(i) = p(x = i) = \frac{n_i}{n} \;, 0 \leq i < L$$

L being the total number of gray levels in the image (typically 256), n being the total number of pixels in the image, and $p_x(i)$ being in fact the image's histogram for pixel value i, normalized to [0,1].

Let us also define the cumulative distribution function corresponding to p_x as

$$cdf_x(i) = \sum_{j=0}^{i} p_x(j)$$

Which is also the image's accumulated normalized histogram.

We would like to create a transformation of the form $y = T(x)$ to produce a new image $\{y\}$, with a flat histogram. Such an image would have a linearized CDF across the value range, i.e. for some constant K.

$$cdf_y(\mathrm{i}) = \mathrm{iK}$$

The properties of the CDF allow us to perform such a transform it is defined as

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 7, July 2014

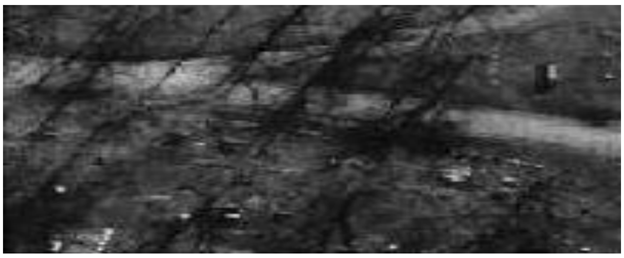
$$cdf_y(y') = cdf_y(\mathrm{T(k)}) = \mathrm{cdf_x}(k)$$

Where k is in the range [0, L].
Notice that T maps the levels into the range [0, 1], since we used a normalized histogram of {x}. In order to map the values back into their original range, the following simple transformation needs to be applied on the result:

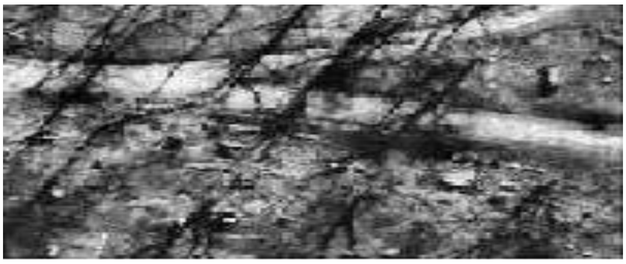
$$y' = y.(\max\{x\}) - \min\{x\}) + \min\{x\}$$

B. Adaptive Histogram Equalization

Adaptive histogram equalization is other image processing technique that is extended version of histogram equalization. This method is differs from histogram equalization because it computes several histograms, each parallel to a different section of the image, and uses them to redistribute the brightness values of the image. Therefore adaptive method is suitable for improving the local contrast of an image. In Adaptive histogram equalization, the image is divided into several rectangular domains, along with compute an equalizing histogram and modifies levels so that they match across boundaries. Adaptive histogram equalization uses the histogram equalization mapping function supported over a certain size of a local window to determine each enhanced density value. Therefore regions occupying different gray scale ranges can be enhanced simultaneously. But still, the image may have a problem in local contrast. Therefore need to apply histogram modification to each pixel based on the histogram of pixels that are neighbors to a given pixel. This will probably result in maximum contrast enhancement.
However, AHE has a tendency to ended intensify noise in relatively identical regions of an image. It represents a characteristic length scale. Contrast at smaller scales is enhanced, while contrast at larger scales is reduced. Due to the nature of histogram equalization, the result value of a pixel under AHE is proportional to its rank among the pixels in its neighborhood. An efficient implementation on specialist hardware is allowed by this method that can compare the center pixel with all other pixels in the neighborhood. An un-normalized result value can be calculated by adding 2 for each pixel with a smaller value than the center pixel, and adding 1 for each pixel with equal value. When the image region neighboring a pixel is quite identical, its histogram is strongly hit the highest pointed, and the transformation function map a narrow range of pixel values to the whole range of the result image. That is why AHE to over enlarge small amounts of noise in largely identical regions of the image.



(a)



(b)

Fig3. (a) Original image (b) adaptive histogram equalization based image

C. Contrast Limited AHE

Adaptive histogram equalization divides an image into regions and selects a sliding window. The sliding window is processed by means of local histogram equalization. AHE can enhance the contrast of each region. Even AHE is applied widely and revealed effectively, though, there are two problems in adaptive histogram equalization slow speed and the enhancement of noise in relative homogeneous regions. When the relative region is fixed, the local histogram of a pixel is the same as the pixel which is in the center of the Rectangular Window. Only the pixels within the local area are considered while others are neglected. But according to the characteristic of human vision, the visual systems change with the relative region and they are affected by the surrounding environment. This method is variant of adaptive histogram equalization called *contrast limited adaptive histogram equalization* (CLAHE) prevents this problem by preventing the amplification of noise. Thus, according to the application of Contrast Limited Adaptive Histogram Equalization (CLAHE), it is more suitable alternative as it fulfils all the desired objectives such as image clarity (fullest intensity), equalizing the contrast projection, and preventing over-amplification of noise signals by impressive restrictive characteristic.
The contrast amplification in the neighbourhood of a given pixels value is given by the slope of the transformation function. This is proportional to the slope of the neighbourhood cumulative distribution function and therefore to the value of the histogram at the pixel value. The general equation for contrast limited adaptive histogram equalization is

$$N_{aver} = \frac{N_{CR-Xp} \times N_{CR-Yp}}{N_{gray}}$$

Where N_{aver} is average number of pixels, N_{gray} is number of gray level in the contextual region, $N_{CR-Xp}$is the number of pixel in the X-dimension in the contextual region, N_{CR-Yp} is the number of pixel in Y-dimension in the contextual region.

(a)

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 7, July 2014

(b)

Figure4. (a) Original image b) contrast limited adaptive histogram equalization based image

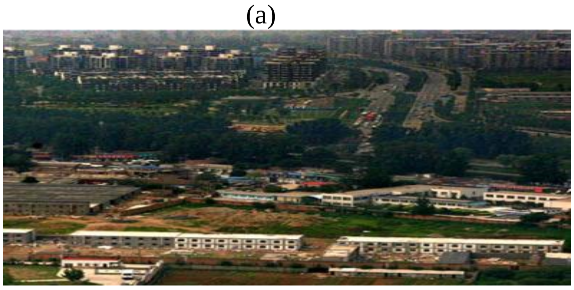
D. Dark channel prior

The dark channel prior is based on haze-free outdoor images: in most of the non-sky area, at least one color channel has very low intensity at some pixels. For example in color images, any one of the red, blue and green colors may have a less intensity. In other words, the minimum intensity in such an area should have a very low value. Formally, for an image **J**, we define

$$J_{dark}\,(x) = min_{c\epsilon\{r,g,b\}}\left(\min y_{\in\Omega(x)}\left(J_C(y)\right)\right)$$

Where J_c is a color channel of **J** and $\Omega(x)$ is a local patch centered at *x*. Observation says that except for the sky region, the intensity of J_{dark} is low and tends to be zero, if **J** is a haze-free outdoor image. J_{dark} is the dark channel of **J**.

(a)



(b)

Figure5. (a) Original image (b) dark prior channel based image

The low intensities in the dark channel are mainly due to three factors: a) shadows. *e.g.*, the shadows of cars, buildings and the inside of windows in cityscape images, or the shadows of leaves, trees and rocks in landscape images; b) colorful objects or surfaces. *e.g.*, any object (for example, green grass/tree/plant, red or yellow flower/leaf, and blue water surface) lacking color in any color channel will result in low values in the dark channel; c) dark objects or surfaces *for example* dark tree trunk and stone. As the natural outdoor images are usually full of shadows and colorful, the dark channels of these images are really dark!

E. Dominant brightness level

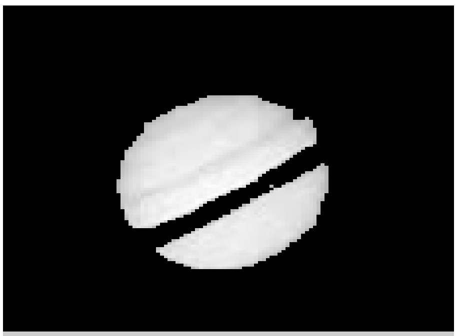
Dominant brightness level method enhances the overall image quality and visibility of local details effectively, and minimizes the pixel distortions in low and high intensity. Remote sensing and Digital Cameras are the applications of this technique. For safely including the practical range of dominant brightness, we used 0.4 and 0.7 for the low and high bounds, respectively.

Existing histogram-based contrast enhancement methods cannot preserve edge details and exhibit saturation artifacts in low and high intensity regions so a novel contrast enhancement algorithm is prepared for remote sensing images using dominant brightness level-based adaptive intensity transformation as shown in Fig.6 Even if intensity distributions vary spatially, the correspondingly contrast-enhanced images may have lose image details and intensity distortion in some regions. For prevail over the intensity distortion problems, we decompose the input image into multiple layer of single dominant brightness levels. Since low-intensity values are dominant in the dark region, and high-intensity values are dominant in the bright region, the dominant Brightness at the position(x, y) is computed as

$$D(x,y) = exp\left(\frac{1}{N_l}\sum_{(x,y)\in S}(\log l(x,y) + \varepsilon)\right)$$

where S represents a rectangular region encompassing(x, y), L(x, y)represents the pixel intensity at(x, y), N_L represents the total number of pixels in S, and ε represents a sufficiently small constant that prevents the log function from changing to negative infinity. In the low-intensity layer, the dominant brightness is lower than the pre-specified low bound and vice versa. The middle-intensity layer has the dominant brightness in between low and high bounds.

(a)



(b)

Figure6. (a) Original image (b) dominant brightness level based image

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 7, July 2014

III. LITERATURE SURVEY

Saibabu and Vijayan(2006)[1] introduced an Adaptive and Non Linear Technique for Enhancement of Extremely High Contrast Images for some extremely bright and dark regions in the night images. Authors found that some previous methods worked well for dark images and some for bright images, but not worked well for both type of images. So they used three methods such as adaptive intensity enhancement, contrast enhancement and color restoration to make the algorithm more adaptable to the image characteristics.

Alexander Wong and William (2008) [2] presented a new perceptually-adaptive technique for enhancement of information within still images for persons who were suffering from dichromacy. They applied a non-linear hue remapping method to the still images for improving color differentiation while preserving the visuals of the images by stretching dynamic range of red-green or blue-yellow colors of images. Authors observed that previous techniques did not preserve the visual of the original color image. So they gave this new technique for producing enhanced images that preserve visual detail along with maintain the aesthetics of the original image.

Junxuan and Ke Zhang (2010)[3] described Adaptive Color Restoration and Luminance Based Multi Scale Retinex Scheme to improve the visual quality of color images under poor lighting condition. They declared that Red, Green, Blue color bands improved by amending luminance which automatically enhanced to a proper range based on Human Visual System using the adaptive parameter.

Authors found in the previous research that A luminance based Multi-scale Retinex improved darker images in the poor lightening areas along with saving CPU time largely, but it doesn't work in other images as effectively as 'darker objects with brighter background' in the images and 'whole black background' images.

So they improved the previous Luminance Based Multi Scale Retinex by extended into Adaptive Color Restoration Luminance Multiscale retinex to achieve better visual results by perceiving more details and without varying percentage of R, G, and B in the three bands.

N. M. Kwok and et al. (2010)[4] demonstrated local sector enhancement technique to address the problems such as to preserve the color information content while enhancing the contrast and image quality by making use of local contrast information and fusing the enhanced image with the original.

They introduced that enhanced sectors were modulated by a Gaussian mask to mitigate unexpected changes at the sector boundaries. Local sectors with higher contrast dominated the others thus achieving overall global contrast enhancement.

They claimed performance of this approach was evaluated by using a collection of color images taken under dissimilar conditions. Authors had found some limitations in previous research that had been exposed in global histogram equalization approaches including unnatural artifacts produced and loss of object details.

Kota and et al. (2010) [5] studied that HE caused an effect on brightness, shadow in some almost homogeneous area. So to control enhancement degree and maintain brightness, they proposed two methods such as HE with variable enhancement degree and Brightness preserving Bi-HE with Variable Enhancement Degree which are extended version of HE and Brightness Preserving Bi-HE respectively. They claimed that later method realized the natural enhancement and permitted some different mean brightness between the original image and the enhanced image.

They introduced Modified Histogram Equalization for Image Contrast Enhancement method in which the image histogram is divided into two parts and after that two histograms are independently equalized.

Fan Yang, Jin Wu (2010) [6] introduced an improved image contrast enhancement based on HE, which is especially suitable for multiple-peak images. They found some disadvantages in previous research that some algorithms increased contrast of the images but they usually produce certain undesirable effects in the results. So they claimed that new method presented an efficient algorithm in achieving widely dynamic range and improving contrast of the images.

They applied Gaussian filter for removing noise in images and the valley values of the image histogram divided the original histogram into different areas. Histogram equalization method applied on each segment separately. They also proved that present method was better than as compared with HE and Bi-HE.

Deepak and Joonwhoan Lee (2011) [7] introduced a Nonlinear Transfer Function-Based Local Approach for Color Image Enhancement method for enhancing the color image in which pixel neighborhood method and overlapped window based method applied on only V component of the Hue Saturation Value color image, but H and S component are not changed to prevent the degradation of color balance between HSV components.

Authors found in previous research that HVS and compressed Discrete Cosine Transform domain method enhanced both dark and bright region of an image equally well but not enhance all parts of the image very well. A local approach was applied on V components instead of global approach. Luminance all over the image was not same, some regions may be dark or bright so the image locality was to be considered while enhancing.

M. C. Hanumantharaju and et al. (2011) [8]: introduced a new algorithm and architecture suitable for Field Programmable Gate Array implementation of adaptive color image enhancement based on Hue-Saturation-Value color space. By stretching dynamic range, the saturation component was enhanced to get rich color display. In order to avoid color alteration, Hue was retained.

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 7, July 2014

They found in previous research that traditional arithmetic mean filter tends to lose image detail such as edges and sharpness when compared to geometric mean filter and reconstructed quality of image using this scheme was generally not satisfactory. So an adaptive luminance enhancement was attained by using a simple geometric mean filter instead of arithmetic mean filter and also used to achieve very good quality reconstructed images. For speed up the enhancement process, Pipelining and parallel processing techniques had been adapted.

Apurba and Ashish (2011)[9]: introduced Particle Swarm Optimization based hue preserving color image enhancement technique to improve image quality by maximizing the details in the input image and to solve the optimization problem. They stated that parameterized transformation function used to enhance the quality of the intensity image, in which parameters were optimized by Particle Swarm Optimization based on an objective function. This function also used local and global information of the input image and the objective function considers the entropy and edge information to measure the image quality.
They found that algorithm gave better results as compared with Hue-Preserving Color Image Enhancement without gamut problem and a Genetic Algorithm based approach to Color Image Enhancement**.**

Zhiyuan and et al. (2011) [10] introduced Example-based Dist-Stretched contrast enhancement algorithm to enhance the image contrast effectively. They described problems of traditional HE methods and also stated that resulted images from this method had more natural looking than those of traditional HE based methods. So they proposed classical version of HE that used globally redistribute pixel values in the stretched dynamic range by creating a linear cumulative histogram.
Therefore, by studying the associated properties of the histogram of the example image, the target image enhanced towards similar visual appearance of the example image. They described the basic principle of the ExDS algorithm that the target and the example images share similar scene or tonal distributions.

Yi-Sheng Chiu and et al. (2011)[11] : introduced an Efficient Contrast Enhancement Using Adaptive Gamma Correction and Cumulative Intensity Distribution method in which an automatic transformation technique used to improve the brightness of dimmed images based on the gamma correction and probability distribution of the luminance pixel.
They firstly described histogram analysis which provided the spatial details of the single image based on probability and statistical inference. Authors stated the weighting distribution for smoothing and gamma correction for enhancing.
They claimed that it provided better contrast based on the comparison with previous research techniques which didn’t attain the proper balance between the image trend preservation and the image enhancement.

Junjun and et al. (2011) [12]: introduced a novel Modified Multiscale Contrast Enhancement technique based on manipulating the Discrete Cosine Transform coefficients was an improved version of previous methods. They proposed a technique that used an image contrast measure Second-Derivative-like Measure of Enhancement to choose the optimal parameters and to demonstrate the effectiveness of the methods.
Authors stated that proposed method behaved low frequency and high frequency coefficients differently to suppress the block artifacts and protect large edge details in the low frequency components.
Alpha rooting and logarithmic enhancement function to the band enhancement provided high flexibility to modify the Discrete Cosine Transform coefficients and also provided more balanced results than applying the individual techniques alone.

Rajib Kumar and et al. (2012) [13] introduced a internal noise induced contrast enhancement of dark images in which Dynamic Stochastic Resonance was applied on DCT coefficient iteratively to enhance the image energy by making a energy transition into another state, or with inter-well transition of a particle in a bistable double well system.
They found that present method gave least iteration in comparison others techniques and due to adaptive sub-block selection or Dynamic Stochastic Resonance, it enhanced very dark as well as low contrast images very effectively with negligible loss of information at the bright areas. It was not only adjusted the background illumination but also improve contrast while preserving enhancing color information.

Farhan and et al. (2012) [14] introduced a Weighted Average Multi Segment HE method using Gaussian filter which applied on original images for preserving mean brightness and reducing noise. They found that the brightness of the input image shifted to the mid gray level and failed to preserve brightness. Some previous techniques preserved brightness but introduced undesirable artifacts.
They declared that mean brightness of processed image located in the middle of the input mean and the middle gray level and Weighted Average Multi Segment HE was a hybrid form of three methods such as Multi Peak HE with Brightness Preserving method, Minimum Within-Class Variance Multi HE and Recursive Mean-separate HE. These three methods provided better results together.

H. D. Cheng and Yingtao Zhang (2012)[15] focused that Over-enhancement lead to the loss of edges, textures, fine details, and unnatural images which was the major problem of image contrast enhancement algorithms. They claimed that a novel method which investigated, analyzed and detected reasons of over-enhancement and located the over enhanced areas accurately and effectively, and provided a quantitative criterion. They found that there was no accurate, effective method for detecting over-enhancement yet. But without a good detection method, it affected and hampered the development of image enhancement techniques greatly. Authors also stated that to avoid over-enhancement, some algorithms controlled the intensity range of the processed images but the major drawback of was under-enhancement which made some parts of the images enhanced insufficiently. Some algorithms studied the performance of the enhancement only using the contrast ratio without investigating and discussing the over enhancement; therefore, the results often had serious over-enhancement separation measure. They claimed that over-enhancement was detected if the value of SMO was greater than a threshold T.

Sunanda S. Alur and Hanumantharaju (2012) [16] introduced a novel wavelet-based dynamic range compression algorithm to improve the visual quality of images and it had limited capability of dynamic range for both dark and brighter regions of a scene. They claimed that for each block dynamic range compression, Gabor filter applied on approximation coefficients using nonlinear transfer function which provided better results than previous filters. Authors described that the enhancement was applied to the value component and saturation of the image, and by stretching its dynamic range to get rich color display. The Hue component was preserved for balancing in HVS. The wavelet transform technique used to reduce the dimension of the image. The detail coefficients were also modified to prevent the edge distortion.

Devan and et al. (2013) [17] introduced Color Image Enhancement Using Non-linear Transfer Function And Quality Measurement Using Reduce Reference Metrics to improve an image. It was based on two independent processes luminance enhancement and contrast enhancement. Authors found in previous research that when an image was converted from one form to other, it degraded some time, so to remove degradation such images, enhancement techniques are applied.
They studied that for the luminance enhancement, only V component of the image are changed which didn't affect the original color of enhanced image. Luminance enhancement applied to the image through a pixel intensity transformation that was implemented by using a nonlinear transfer function. They also declared that this transfer function was adjusted to achieve appropriate luminance enhancement. Four new reduced references metrics methods produced better images.

Haocheng Wen and Yonghong Tian (2013) [18]: introduced that due to spreading of light in water, the clarity of images or videos captured under water was usually decreased by varying degrees. So they declared that according to the difference in light reduction between in atmosphere and under water, a new underwater optical model proposed which described the formation of an underwater image in the true physical process. Authors also claimed that a new underwater dark channel was derived to estimate the scattering rate, the background light in the underwater optical model. They also improved adaptability and flexibility.

Yuan Mei, Bo Zhao, and et al. (2014)[19]: introduced a Orthogonal curved-line Gabor filter for fast fingerprint enhancement technique which used to improve the clarity of finger print ridge structure in the previous research, curved Gabor method achieved a state of art enhancement effect but high computation makes a drawback so this novel technique removed it by Gabor filer. They stated that to overcome the high computation 1-D low pass Gabor filtering and 1-D band pass filtering applied on parallel and perpendicular curved lines to the edge orientation respectively. This new algorithm was 42 times faster than previous.

Muhammad Suzuri Hitam, and et al.(2013)[20] had introduced that due to poor visibility of underwater images that is caused by physical properties of the water medium, there was need to improve the quality of an underwater image. They also presented mixture Contrast Limited Adaptive Histogram Equalization (CLAHE) color models that specifically developed for underwater image enhancement. The method operates CLAHE on RGB and HSV color models and both results were combined together using Euclidean norm. They had taken underwater images from Redang Island and Bidong Island in Terengganu, Malaysia. Authors found that this approach improved the visual quality of underwater images by enhancing contrast, as well as reducing noise and artifacts. They declared that this algorithm produced the lowest MSE and the highest PSNR values

IV. GAPS IN EXISTING LITERATURE

Image enhancement algorithms become more beneficial for numerous vision applications. It has been observed that the most of the existing research have neglected numerous subjects. Following are the various research gaps concluded using the literature survey:-

- The existing methods have neglected the techniques to reduce the noise issue which is presented in the output images of the existing image enhancement algorithms.
- Not much effort has focused on the integrated approach of the Adaptive gamma correction and Dark channel prior.
- The problem of the uneven illuminate is also neglected by the most of the researchers.

V. CONCLUSION

The version of this template is V2. Most of the formatting instructions in this document have been compiled by Causal Productions from the IEEE LaTeX style files. Causal Productions offers both A4 templates and US Letter templates for LaTeX and Microsoft Word. The LaTeX templates depend on the official IEEEtran.cls and IEEEtran.bst files, whereas the Microsoft Word templates are self-contained.

ACKNOWLEDGMENT

The authors would like to thank the department of computer science of BCET, Gurdaspur regional campus of Punjab technical, university india for this project.

REFERENCES

[1] Alexander Wong, William, "perceptually-adaptive technique for enhancing of still images for individuals with dichromacy", 2008.
[2] Apurba Gorai ,Ashish Ghosh, "Hue-Preserving Color Image Enhancement Using Particle Swarm Optimization", 2011.
[3] Deepak Ghimire and Joonwhoan Lee, "Nonlinear Transfer Function-Based Local Approach for Color Image Enhancement", IEEE Transactions on Consumer Electronics, Vol. 57, No. 2, May 2011.
[4] Divya Devan, Sree lekshmi Das, Neethu S.S, Shreyas L, "Color Image Enhancement Using Non Linear Transfer Function and Quality Measurement Using Reduce Reference metrics", IOSR Journal of Engineering (IOSRJEN) Vol. 3, Issue 1 (Jan. 2013).
[5] Fan Yang, Jin Wu, "An Improved Image Contrast Enhancement in Multiple-Peak Images Based on Histogram Equalization", 201O International Conference On Computer Design And Applications (ICCDA 2010), 25-27 June 2010.
[6] Haocheng Wen and Yonghong Tian, "Single Underwater Image Enhancement with a New Optical Model", 19-23 May 2013.
[7] H. D. Cheng and Yingtao Zhang, "Detecting of contrast over-enhancement", Sept. 30- 3 Oct. 2012.
[8] Junjun Xia, Karen Panetta, "Color Image Enhancement Algorithms based on the DCT Domain", 9-12 Oct. 2011.
[9] Junxuan Yan and Ke Zhang, "Adaptive Color Restoration and Luminance MSR Based Scheme for Image Enhancement", 27-29 March 2010.
[10] Kota Murahira, Takashi Kawakami, and Akira Taguchi," Modified Histogram Equalization for Image Contrast Enhancement", Proceedings of the 4th International Symposium on Communications, Control and Signal Processing, ISCCSP 2010, Limassol, Cyprus, 3-5 March 2010.
[11] M. C Hanumantharaju1, M. Ravishankar1, D. R Rameshbabu2, S. Ramachandran3, "A Novel PGA Implementation of Adaptive Color Image Enhancement based on HSV Color Space", 8-10 April 2011.
[12] Mohd. Farhan Khan, Ekram Khan and Z.A. Abbasi, "Weighted Average Multi segment histogram equalization for brightness preserving contrast enhancement", 15-17 March 2012.
[13] N. M. Kwok, Q. P. Ha, G. Fang, A. B. Rad and D. Wang, " Color Image Contrast Enhancement using a Local Equalization and Weighted Sum Approach", 6th annual IEEE Conference on Automation Science and Engineering , August 21-24, 2010.
[14] Rajib Kumar Jha, Rajlaxmi Chouhan, P. K. Biswas, Kiyoharu Aizawa, "Internal Noise Induced Contrast Enhancement Of Dark Images", 2012.
[15] Saibabu Arigela and K. Vijayan Asari, "An Adaptive and Non Linear Technique for Enhancement of Extremely High Contrast Images", 35th Applied Imagery and Pattern Recognition Workshop (AIPR'06), 11-13 Oct. 2006.
[16] Sunanda. S Alur and M. C Hanumantharaju, "A Novel Approach Based On Wavelet and Non-Linear Transfer Function-Based Local Approach for Real Color Image Enhancement", 2012 International Conference on Computing Sciences, 14-15 September 2012.
[17] Yi-Sheng Chiu, Fan-Chieh Cheng, "Efficient Contrast Enhancement Using Adaptive Gamma Correction and Cumulative Intensity Distribution method", 2011.
[18] Yuan Mei, Bo Zhao, Yu Zhou and Songcan Chen, "Orthogonal curved-line Gabor filter for fast fingerprint enhancement", Vol. 50 No. 3 pp. 175–177, 30th January 2014
[19] Zhiyuan Zhou, Xiaokang Yang, Li Chen, Guangtao Zhai, Wenjun Zhang, "Example-based Image Contrast Enhancement", 17-19 Oct 2011.
[20] Eunsung Lee, SangjinKim, Wonseok Kang, Doochun Seo, and JoonkiPaik, "Contrast Enhancement Using Dominant Brightness Level Analysis and Adaptive Intensity Transformation for Remote Sensing Images", VOL.10, NO.1, JANUARY2013.
[21] Muhammad Suzuri Hitam, Wan Nural Jawahir Hj Wan Yussof, Ezmahamrul Afreen Awalludin, Zainuddin Bachok, "Mixture Contrast Limited Adaptive Histogram Equalization for Underwater Image Enhancement", 2013.

BIOGRAPHY

Myself **Varinderjit kaur**, I was born in India on 11 Nov, 1985. I received the B. E. degree in computer engineering from SLIET University, India in 2009. I am pursuing the master degree in computer engineering from Punjab technical university. My research interests include image processing.