Chapter 1

INTRODUCTION

Contrast image enhancement method is used to process an image so that the visual content of output image is more pleasing or more useful for different areas such that medical, satellite imaging or machine vision application. However choosing an appropriate image is not easy because of the quality of image. There are many algorithm is proposed for the image enhancement such as histogram equalization, local histogram equalization, adaptive image enhancement etc.

Local histogram equalization in [1] uses a small windows that pass to every image pixels and histogram for the current pixel is equalized within the widow. For image enhancement the gray level mapping is applied only to the center pixel of current window that passes through the given image. Local histogram enhancement some times over enhanced the given input image and produces undesirable noise and undesirable checker effect to the given input image. The window size selection for the Local histogram enhancement increases the computational complexity of algorithm. Algorithm that works for improving the histogram equalization include brightness maintain is bi histogram equalization (BHHE) [2]. Histogram equalization is used for contrast adjustment of image using the image histogram. Histogram equalization increase the global contrast of an image. The histogram equalization works well when the foreground and background both are dark or bright. The histogram equalization distribute the gray level intensity so that the histogram tends to distribute the intensity level throughout the image to increase the contrast of an image.

Two Dimensional Histogram equalization which utilizes the contextual pixel i.e. neighbor of pixel to enhance the quality of an image [3]. The 2 Dimensional Histogram equalization increases the grey level differences between the pixel and its neighborhood pixels, the image equalization is achieved by considering that for a given input image, the absolute value of the gray level differences between pixels and its neighborhood pixels are equally distributed. In Two Dimensional histogram equalization the only computational complexity is to find the window size that is used to apply on the given image. Optimization algorithm also used for enhancement the image. Converse optimization is used when the histogram specification is that with accurate brightness preservation, to convert the given image histogram into the flat histogram [4]. Flattest histogram work very similar to histogram equalization when the gray level of the given image is equally distributed.

In this project, we proposed an adaptive procedure i.e. Image enhancement using adaptive transformation. In this project we used the adaptive procedure technique for the image and then apply the power law transformation, where the gamma value is calculated by taking the difference max of pixels value in a window to the min values of window size, the difference values then takin in log where denominator is difference and numerator is 1, the overall values is the divided by windows size. The given method gives the good contrast to the image which overall improve the image quality.

The quality of image is enhance when we apply the proposed algorithm. The overall contrast of the image is increase and dark images can also be seen clearly. The transformation function used for each pixel of the given image is processed on the window that is used to pass through the given image. The processed image depends on the window size, because the techniques works for the given window.

If we increase the window size then the center pixel value is calculated for larger region that is the center pixel will be affected by the more number of pixels. In this technique we firstly convert the given input image to two dimensional histogram and then we normalize that image, after normalizing the image we used the mapping function to map the calculated pixel value corresponding to the given gray level histogram of image. The two dimensional histogram is constructed for each gray level of the given input image to the distribution of the other gray levels in neighborhood of the corresponding pixel is computed that two dimensional histogram is then used for the mapping process.

In order to increase the quality of the given image grey level is transformed to the output gray level using cumulative distribution function. This output image then used as a input to the technique where the input gray level is transformed to the output gray level using power law transformation function, where the gamma value is calculated as adaptive method techniques. Choosing the window size is little bit complex but with the help of two dimensional histogram technique we uses the same window for this method. The overall quality or enhancement of the image is increased as we have shown in the given Fig. 1.

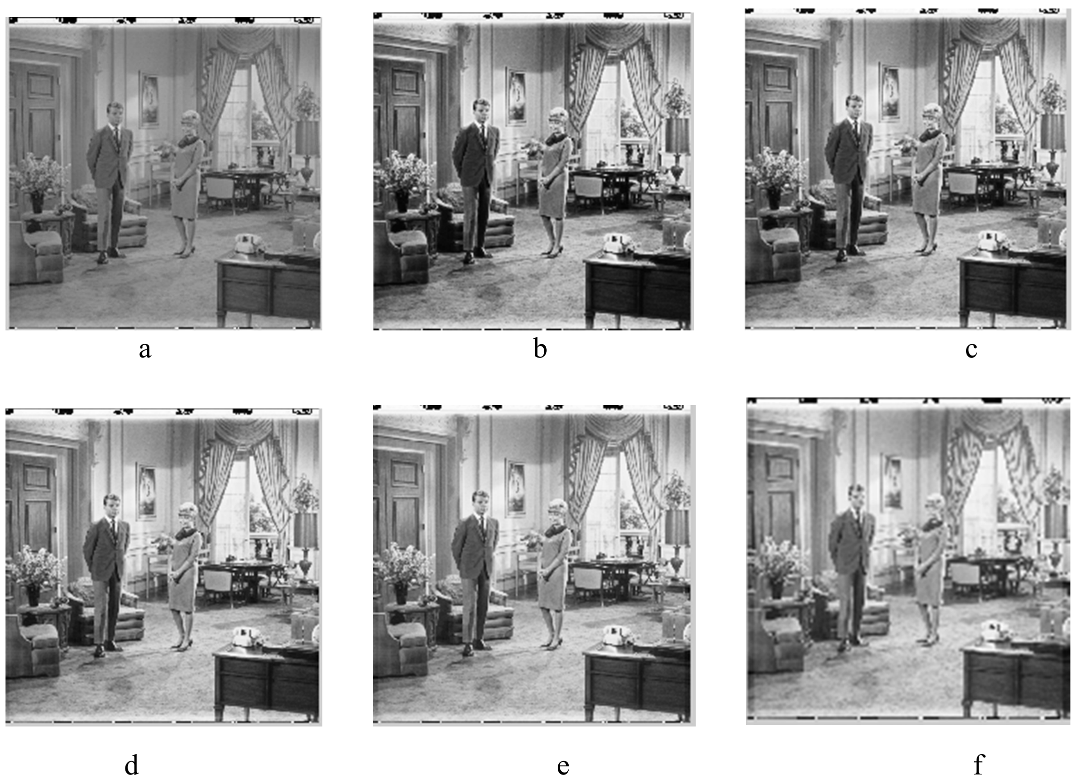


Figure 1.1: Enhancing the input image shown in (a) using different size of local neighborhood. (b) w =3, (c) w=5, (d) w=7, (e) w=9., (f) w=12

Chapter 2

LITERATURE SURVEY

There are many techniques to improve the image quality, among the available technique we are discussing some of them. Histogram utilizes the available gray scale(histogram) of an image efficiently, it transform to over enhance the input image contrast if there is many peaks available in the input image(histogram), resulting in grim and noisy appearance of the enhanced (output) image. This is highly used and most familiar technique available for image enhancement. This technique [5] when processed on an input image, adjust the contrast of the image using the image's histogram, which is based on the probability distribution and cumulative distribution function. The method which we used increased the global contrast of the given images, especially when used data of the image is represented by close contrast values. We can use the histogram equalization as a pre-processor and then make good quality available for the other algorithm. This allows for areas of lower local contrast to gain a higher contrast to achieve a good quality image. Histogram equalization accomplishes this by effectively to stretch out the most frequent intensity values in the input images. The method works good if the images with backgrounds and foregrounds that are both bright or both dark. Histogram equalization is most popular used algorithm for contrast enhancement of the given gray images. If the histogram are uniform distribute then it increase the quality of the images [6]. Local histogram equalization enhance [7] the given image, in this the window size is pass through the image and for each time we compute the histogram equalization for the window size. In this technique the gray level of window pixel is equalized with the computed gray level of window pixel. In this technique the image quality becomes bad in most of the cases because for each time we equalize the pixel corresponding to the window size. If the given image contains more dark region and bright then the overall effect degrade the image quality.

Local histogram equalization in uses a small windows that pass to every image pixels and histogram for the current pixel is equalized within the widow. For image enhancement, the gray level mapping is applied only to the center pixel of current window that passes through the given image. Local histogram enhancement some times over enhanced the given input image and produces undesirable noise and undesirable checker effect to the given input image. The window size selection for the Local histogram enhancement increases the computational complexity of algorithm. Algorithm that works for improving the histogram equalization include brightness maintain is bi histogram equalization (BHHE) [2]. Histogram equalization is used for contrast adjustment of image using the image histogram. Histogram equalization increase the global contrast of an image. The histogram equalization works well when the foreground and background both are dark or bright. The histogram equalization distribute the gray level intensity so that the histogram tends to distribute the intensity level through-out the image to increase the contrast of an image.

Algorithm that works for improving the histogram equalization include brightness maintain is bi histogram equalization [2]. The main moto of this algorithm is to preserve the mean brightness while enhancing the brightness of the given image. The BBHE used the concept where it first divides the image into two sub-image based on the mean of the input image. In this one of the sub-image contains the pixel value less than the mean of the given input image while the other contains the greater than the mean of the given image. The BBHE equalize the sub-image, according to their histogram independently by considering the sample in the formal set are mapped from the bin zero to the bin mean. The next sub-image are mapped from the bin mean to the maximum gray level. Its means the sub-images are mapped up-to mean and mean to maximum gray level respective histogram.

Adaptive histogram equalization is outstanding contrast enhancement technique for natural image and medical and blur images [2]. In medical images its automatic computation and effective representation of all contrast present in the image that make it a possible comparable to the standard contrast enhancement techniques. Adaptive histogram equalization techniques involves to each pixel the histogram equalization mapping based on the pixel in the neighborhood I.e. region surrounded that pixel. Each pixel is mapped according to its rank in the pixel surrounding to its. The adaptive histogram equalization is slow and some-times produces the result that has undesirable features. We can apply multi-level adaptive histogram equalization [7], the multi-level enhance the histogram to good extent and the output contains the desirable features. In the adaptive histogram equalization the window size means the neighbor pixel selection is main computational complexity but there is some automation is used to select the window size. The variance of the AHE is contrast limited adaptive histogram equalization [8], the contrast limited adaptive histogram equalization control the contrast of an image so that the quality of image can be make possible best and the visibility of image can be make clear. The extended version of histogram is bi-histogram equalization [9].

Local histogram equalization related enhancement technique have been developed. The Local histogram equalization [10] uses a small window that pass through every image pixel in a sequentially manner and the histogram of pixels within the given window is equalized for a given image. The grey-level mapping function is applied for enhancement only to the center pixel of the given window. Local histogram equalization sometimes over-enhances of the image. Local histogram equalization based algorithms also gives undesirable checkerboard effects in the images. The computational complexity of Local histogram equalization based algorithms and their requirement for window size selection have led researchers to make possible improve the performance of Histogram equalization using alternative algorithms. Algorithms that focus on improving histogram equalization include brightness preserving bi-histogram equalization, equal area sub-image histogram equalization, minimum mean brightness error bi-histogram equalization, and minimum within-class variance multi-histogram equalization. Brightness error bi-histogram equalization used to solve the brightness preservation problem and uses the mean grey level of the input image pixels to divide the image histogram into two histograms. The two histograms are then independently equalized for the enhancement [2]. Following the same basic ideas used by the Brightness error bi-histogram equalization algorithm of decomposing the original image histogram into two sub-histograms and then equalize the sub-histograms, DSIHE [10] divides the input image histogram into two sub-histograms looking at the maximization of the Shannon's entropy of the output image. Minimum mean brightness error bi-histogram equalization, an extension of Brightness error bi-histogram equalization, gives maximal brightness preservation by finding for a threshold level that divides the input image histogram into two sub-histograms, such that the minimum brightness difference between the given image and the processed image is achieved, whereas the previous algorithms consider only the given image to perform the decomposition. We know these algorithms can achieve good contrast enhancement, the variation in the bin distribution may give result in different side effects. Minimum within class variance multi histogram equalization automatically divides the given histogram into many sub-histograms (each sub-histogram forms a class) by reducing within-class variance and then applies histogram equalization for every sub-histogram independently Minimum within class variance multi histogram equalization applies different programming concept in reducing a cost function formed from within-class variances to get automatic histogram partitioning of the given image. It overcomes the concert of the histogram partitioning algorithms. Minimum within class variance multi histogram equalization succeeds brightness preservation which may result in a low-contrast output image. Optimization algorithms have also been used for enhancing the contrast of the given image. Convex optimization method is used in flattest histogram specification with good prediction brightness preservation, to transform the input image histogram into the distributed flattest histogram, subject to a mean brightness limitation. This is applying an exact histogram specification algorithm to maintain the image brightness. Flattest histogram specification with good prediction brightness preservation behaves nearly same to histogram equalization when the bins of the input image are equally distributed or when the mean brightness value of the input image have dynamic range. It is builds to preserve the average brightness, flattest histogram specification with nearly exact brightness preservation may give low contrast results when the average brightness is weather too low or too high. Contrast enhancement in histogram modified framework is behave as an optimization problem that minimizes a cost function. By using different adaptive parameters, histogram modification can achieve different levels of contrast enhancement. However, these parameters want to be manually alter according to the image content to find high contrast. In order to design a parameter free contrast enhancement algorithm, genetic algorithm is used, to find a require histogram which increases a contrast measure based on edge information. We refer this algorithm as contrast enhancement based on genetic algorithm. Contrast enhancement brightness genetic algorithm subjected from the disadvantages of genetic algorithm based algorithms, namely reliance on initialization and convergence to a local optimization. The transformation to the target histogram is gain only by the increasing contrast, measured using the average edge strength guess from the gradient information. Thus, the overall enhancement may not be smooth. There is other algorithm contrast enhancement using adaptive histogram spatial [12] filtering which gives enhancement images

There are a many number of research work presented in literature that aim at completion the mentioned goal. An early try was made to divides the input image into two sub-images using the average intensity or brightness as threshold in the brightness preserve bi-histogram equalization. The two sub-images were then processed separates using histogram equalization to a target uniform histogram. By the building of this method, an accurate match between the brightness of given and processed images is not generally available. In order to decrease such differences, the separation was make using the median brightness [5]. In the equally area sub-image histogram equalization method, the numbers of pixels presented in the first and second sub-images are equally. It enables a close form answer to find the processed image average brightness, however, its maintenance is still not guaranteed.

Further to the requirement to satisfy average brightness maintenance, avoiding the generation of artifacts due to over-enhancement is also important. A class of technique was hence prepared where the max of the histogram are clip to avoid over-enhancement. An initial develop was suggest; where the given image is first divided into two sub-images using the given image average brightness, known as the bi-histogram equalization with a flat limit method [9]. The clipping limit were find from the average values of the histogram heights of individually sub-images and then use as the require histogram in the equalization. Although over-enhancement can be controls, but due to the changes of the target histogram from a uniformed profile, it is difficult to rudder the processed image average brightness to the required value. The choice of the clip limit is not automatically but it may be known problem specific, such as driven by the subjection or looking perception.

The selection of divided thresholds and clip limits has been address in many research work. A variation named the bi-histogram equalization median plateau reported in where the clip limits was obtain from the median value of the divided sub-images. In fact, this choice of plateau does not permit accurate brightness preservation. Currently, another choice of clip limit was given as the adaptive image enhancement bi-histogram equalization. In the work reported, the given image is divides into the sub-images are separated by the given input median brightness. The plateau took from the minimum of the image histogram value, average value and the median value of the sub-image histogram. This choice of limit may be failed when the median values goes to zero for images bias towards the two end of the intensity range of the images. A further variation was seen, known as the median-mean sub-image clip histogram equalization. In the work present, the given input image was divides into four sub-images for the given image. The first separated was taken using the average intensity while the divisions into four sector used the median value of the two sub-images of the given images. The clip limit for the four obtain sub-image were the median value of individual sector. As can be seen, this process increases computational complexity while the keeping of output image brightness cannot be assure.

We propose an adaptive image enhancement algorithm named as power law transformation algorithm which is effective in terms of improving the visual quality of different types of input images. Power law transformation has only one parameter to tune, namely the size of the neighborhood support which gives the contextual information. It only requires a small number of simple arithmetic operations and is thus suitable for real-time applications. The enhancement process is based on the observation that contrast of an image can be improved by increasing the grey-level differences between the pixels of an input image and their neighbors. There are many algorithm that enhance the images and contrast of the images increases.

Chapter 3

PROPOSED WORK

2.1 MOTIVATION

In many algorithm we have seen the image can be enhance to some extent but the darker region or brighter region over-enhance, like in histogram equalization in some image it over-enhance the image if the histogram of given image is not uniform distributed. In medical images we need more clarity i.e. image should be clearly visible so my algorithm can be used for medical images also and it enhance the image. We can also merge this algorithm with other existing algorithm to get the enhance image. We have seen many algorithm gives good contrast output when the input image is processed, but there is some images on which applying the algorithm does not improve the quality and some features of the image lost, so there are many algorithm than preserve the features and I have applied algorithm that preserve the features and quality of the image. The contrast of the image can be enhanced much if the adaptive procedure used for the processing is using the pixel around the centered pixel of the window in a good manner, I have present the power law transformation function that uses the information of the pixel around the central pixels.

Let g(x, y) is input gray level image given, w is window size i.e. neighborhood pixels. T transformation function, which is used to get the transform for the given images, f(x, y) is output i.e. processed image after applying the transformation function. γ gamma value, d(x, y): difference, h(x, y) is final processed image

2.2 Proposed Algorithm:

Consider the given gray image for each pixel is g(x, y),

Let d(x, y) is the difference that will use to calculate the gamma and can be calculated by:

? È Û Æ (? ? ? ?) (1)

The d1 value calculate the maximum value within the window i.e. neighborhood of the central pixels. The p and q parameter represent up to which the neighborhood pixel we have to consider for the d1 calculation. Where –w/2<=p<=w/2, -w/2<=q<=w/2. w is the window size

? É Û Æ (? ? ? ?) (2)

The d2 value calculate the minimum value within the window i.e. neighborhood of the central pixels.

? (? ?) Æ È – ? É) (3)

The d(x, y) is the difference of maximum value pixel in window and the minimum value in the window, we are finding the difference so that the we can enhance the image.

Now, γ (gamma) can be calculated by taking the log value of difference, from equation (3)

$$\gamma = \ln[(1/d(x, y))/\lfloor w \rfloor \tag{4}$$

The transformation function to get the output of an image will be

$$(\quad) \quad ?(?\ ?)Ø^{2} \tag{5}$$

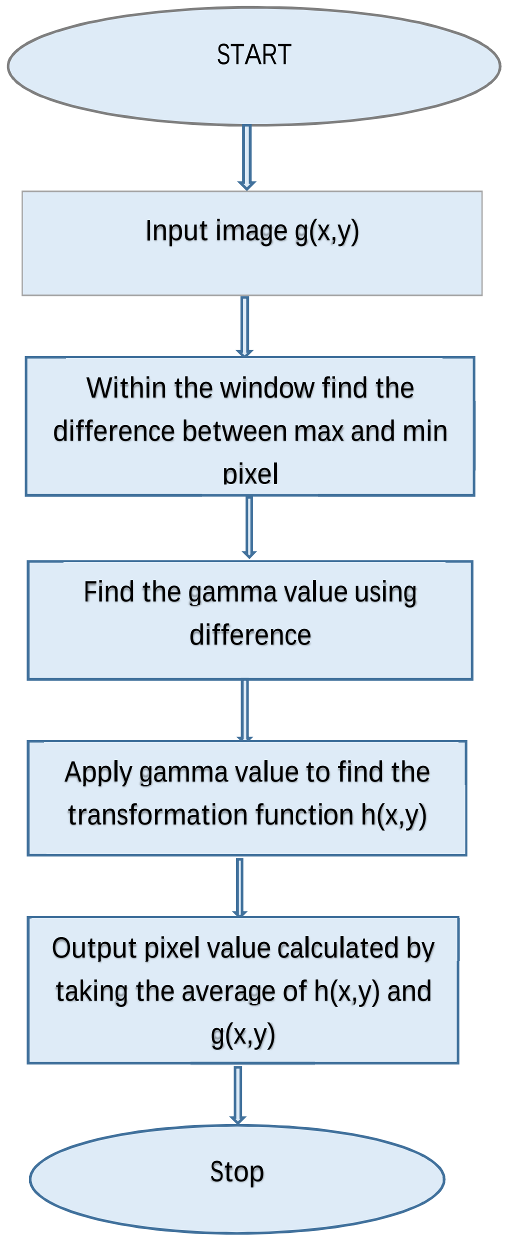
x, y is the co-ordinate value of the given image i.e. pixel value at co-ordinate axis x, y. g(x, y) gives the pixel value of given input image, on which the transformation function is applied. Here we have calculated the gamma value, we can see that if the gamma value is high then the processed image will be more contrast if low then low contrast, but here we have calculated the gamma value in adaptive manner, we took the window size and then we have processed the that particular pixel corresponds to other pixels in the window. Here we used the log term, the work of this is basically average out i.e. if the value of pixel is high then it tends to make it towards the average pixels and if the value of given pixel is low then it tends to make it high. So the basic moto is here making the darker region bright and brighter region towards the average, so that the image can be enhance to a good extents.

The adaptive power law transformation used where it finds the gamma value for each pixels and applied to the transformation function to get the enhanced image. After finding the g'(x, y), we will find the final output value for the enhanced image. From equation (5), we get:

$$?(?\ ?) \quad ?h(?\ ?) \quad ?(?\ ?)?\ ÉØ \tag{6}$$

Where f(x, y) is pixel value of enhanced image. The f(x, y) is calculated after applying the power law transformation on the given gray images and we add the h(x, y) with the given pixel value and divides it by two. Here we are taking the average value of the processed image and the given image. By taking the average of them the overall images are enhance and the contrast of the image enhance to some extent.

Figure 3.1: Enhancing the input image shown in (a) using different size of local neighborhood. (b) w =3, (c) w=5, (d) w=7, (e) w=9, (f) w=12.



Flow Chart: Proposed Algorithm

Chapter 4

Results and Comparison

The proposed algorithm describe in chapter 2 has been implemented in MAT-LAB. Implementation result are presented here with the help of snapshots with the help different image. We also analyzed various parameter used in the scheme and also made comparisons with some existing schemes. The results are as follows:

In figure 3, we have seen that the given image contain the bright pixel value and the histogram of the image contains the intensity towards the bright side. The image is not clearly visible as we can see. After the given image when we apply the adaptive power law transformation the processed image histogram are pixel distributed some extent to uniform and the image becomes enhance. We see the darker region becomes more-darker and brighter region becomes more-brighter and the overall contrast of the image is enhance. The image is processed by taking the different size of the window, when the window size is nine the pixel value is distributed uniform as shown in the given histogram and the processed image becomes enhance.

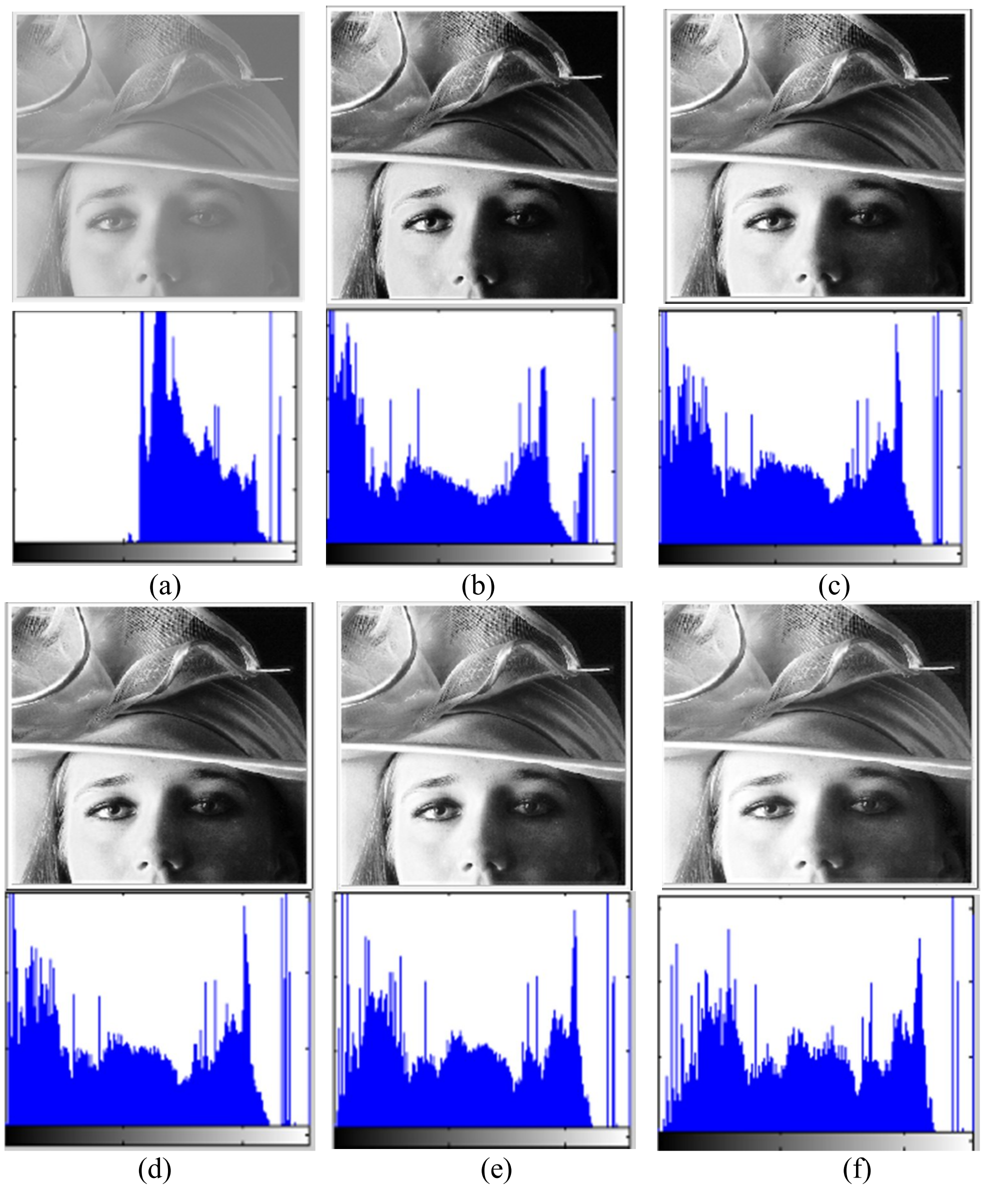


Figure 4.1: (a) Given input image, (b) w=3, (c) w=5, (d) w=7, (e) w=9, (f) w=12, w is the window size with respectively histogram of an image.

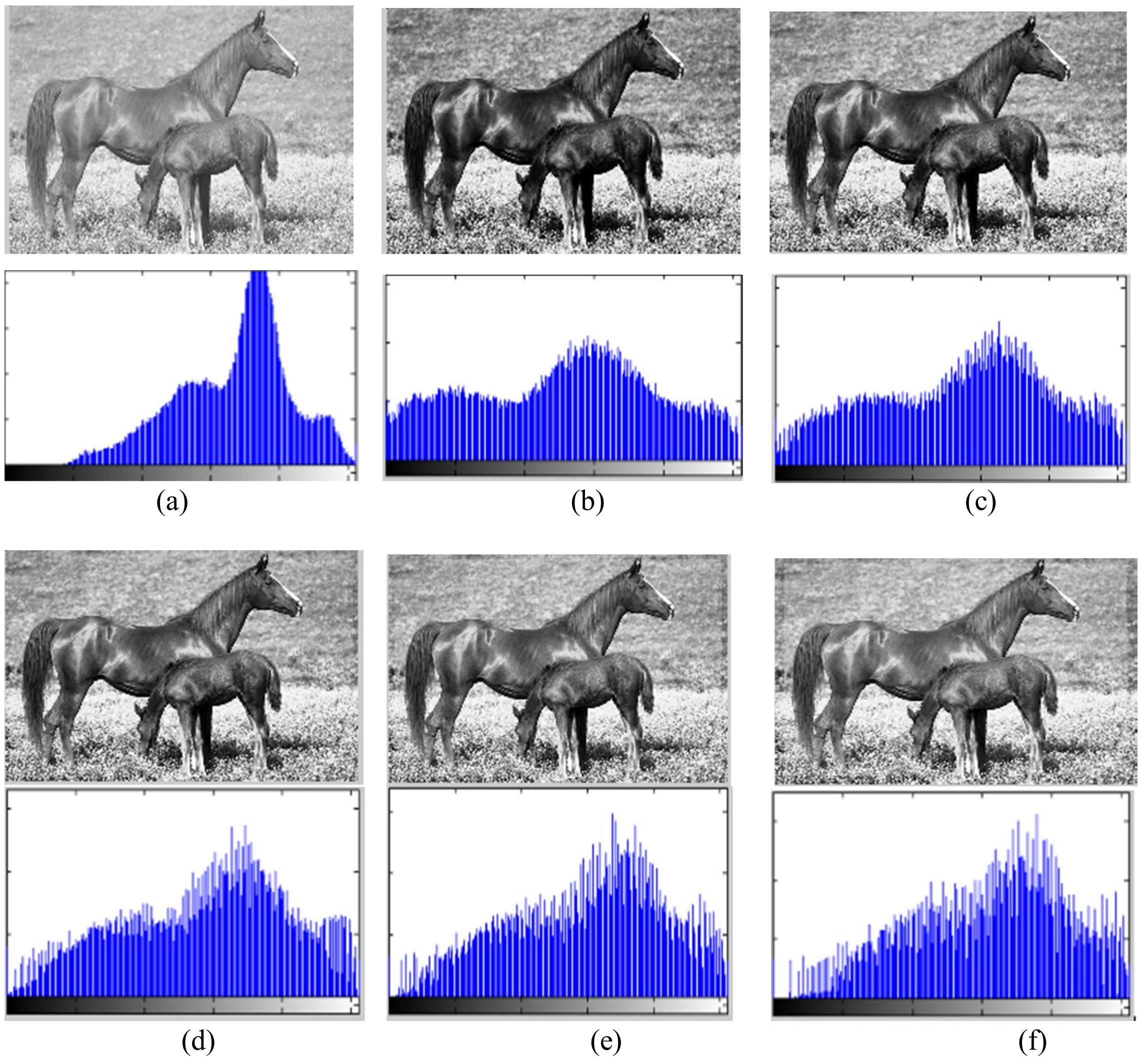


Figure 4.2: (a) Given input image, (b) w=3, (c) w=5, (d) w=7, (e) w=9, (f) w=12 w is the window size with respectively histogram of an image.

As the image shown in the figure 4, the input gray level image is shown with its histogram, the histogram is not uniform distributed and pixels are not uniform distributed, the given image is low contrast. When we apply the algorithm the image becomes the contrast and the histogram contains uniform distributed pixel value. The different window size is used to process the image and the corresponding histogram of its also shown. As we can see that contrast of the image is enhanced by uniform distribution of the intensity i.e. the bin having zeros is less as compared to the input histogram. For different window size the distribution of the intensity differ. The given input image intensity distribution is not uniform, when we apply the adaptive power law transformation it makes darker region brighter and the bright zone getting good contrast, the image quality differ when we use different window because the information contains in the window becomes more and the central pixel can be the calculated more accurately. The power law adaptive transformation is designed to improve visual impact by contrast enhancement without resulting in uncomfortable viewing. The power law transformation depends on the parameter W. Different parameter produce results in different output image. We can fine tune the parameter W according to desired contrast to create desired output. However, there can be automatic parameter setting for choosing the window size.

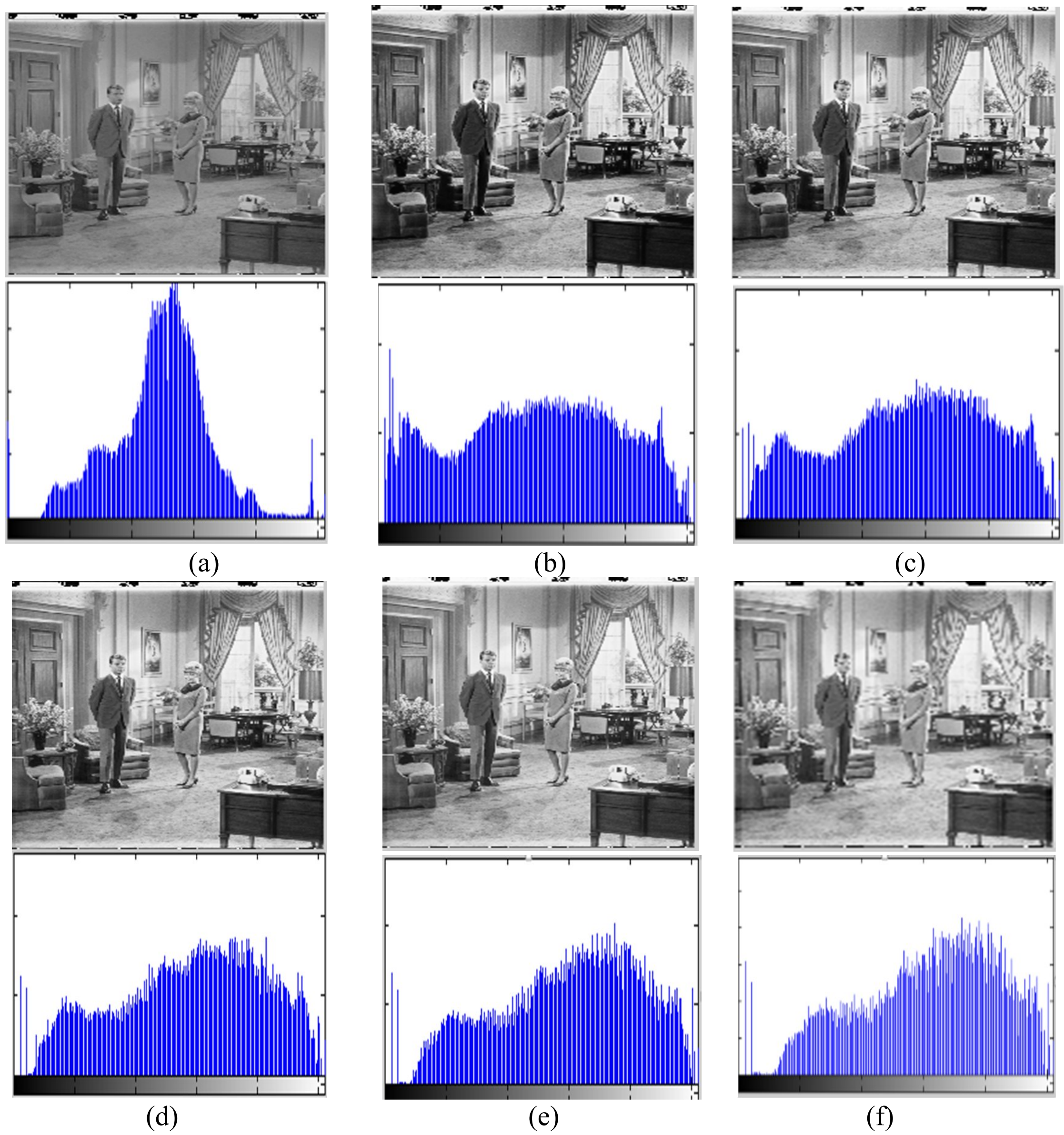
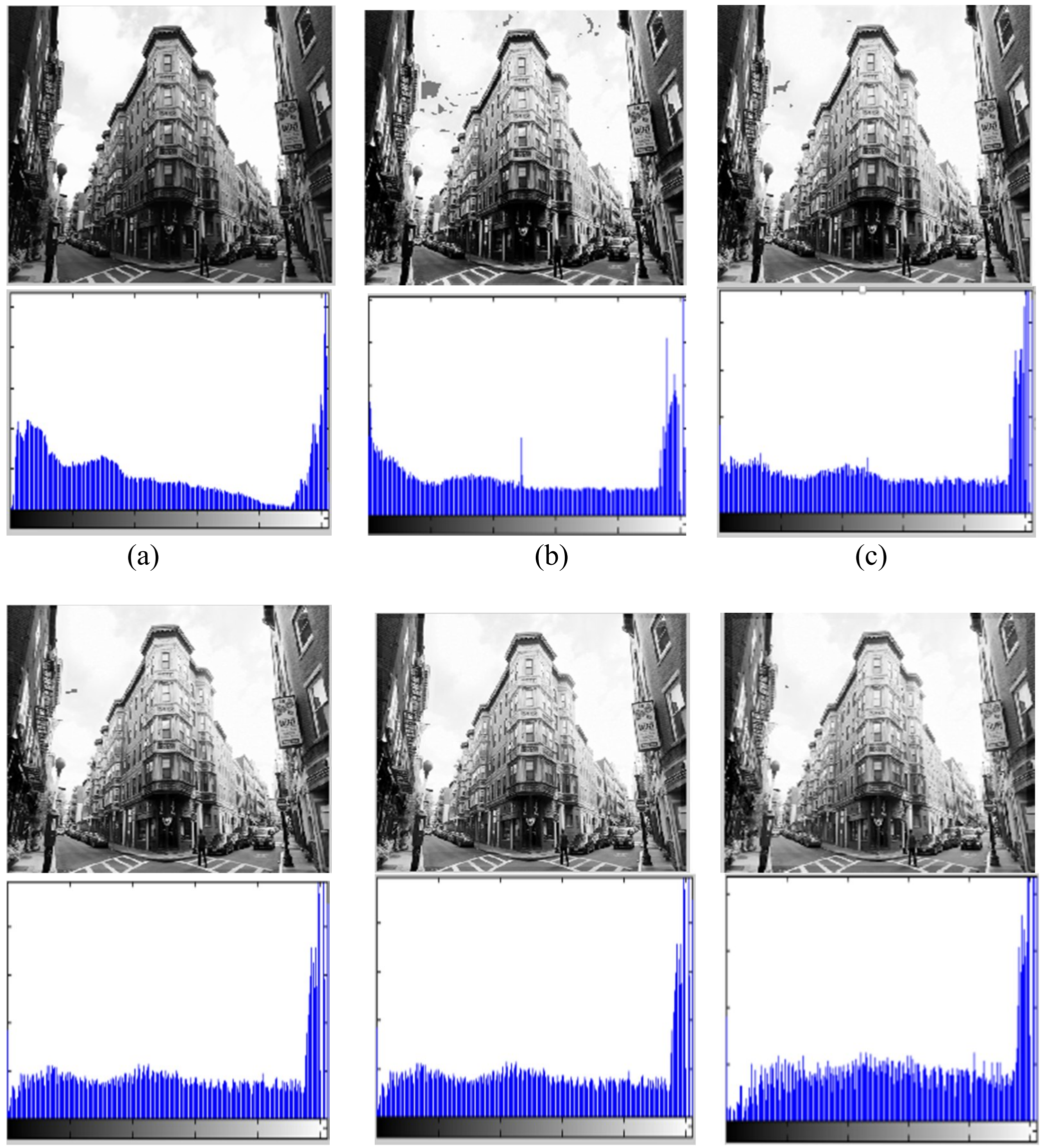


Figure 4.3: (a) Given input image, (b) w=3, (c) w=5, (d) w=7, (e) w=9, (f) w=12 w is the window size with respectively histogram of an image.



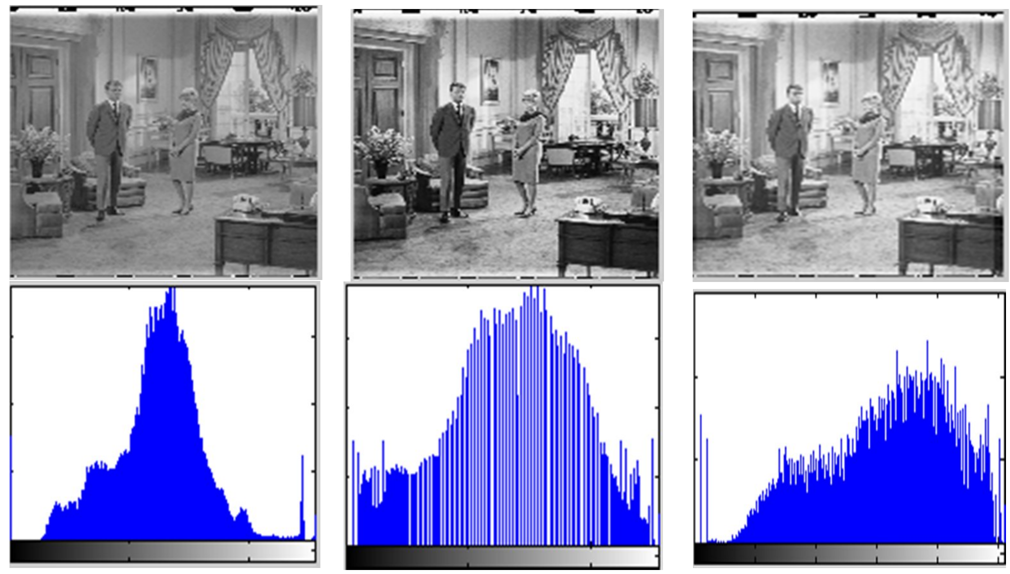
(a) (b) (c)

(d) (e) (f)

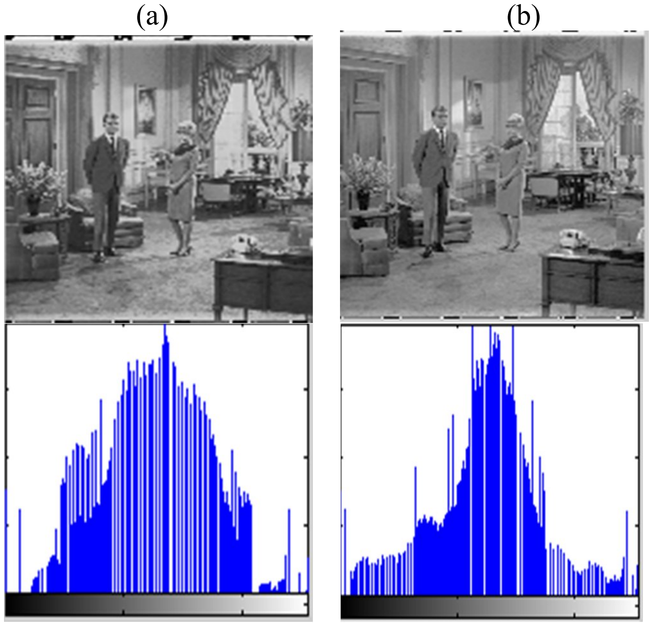
Figure 4.4: (a) Given input image, (b) w=3, (c) w=5, (d) w=7, (e) w=9, (f) w=12, w is the window size with respectively histogram of an image.

The comparison of the output with other existing algorithm has been shown. The adaptive power law gamma transformation shows the good results. The histogram of the processed image is also shown with the images. The output of histogram equalization with the histogram of processed image is shown, in this we can see the contrast of the images are enhance but the processed image are not as much enhance. The image is still low contrast and the histogram is not uniform distribute. The histogram of histogram equalization shows that the most of the intensity values are lies in the range 100-160. As we can see the number of zeros bin in this histogram is more as compared to the other two algorithm. This is also the parameter to find whether the image is enhanced or not.

When we see the 2dhe histogram output the image is more enhanced than the histogram equalization, in this the number of zeros bin is less as compared to the first algorithm. The image is contrast and the histogram contains the uniform distributed pixels. As we can see the histogram the number of zeros bin in the 2dhe is more as compared to proposed algorithm because we increase the brightness of the darker region. The adaptive power law transformation applied on the images is shown with its corresponding histogram, the histogram contains the uniform distributed pixels and the number of bin having zero intensity is lees as compared to the other algorithm. As we can see the contrast of the image is enhanced and the feature of the images is enhanced. The intensity is spread throughout the available bandwidth and the number of zeros bin is less than the other algorithm. As we can see the brightness of the image is also controlled. In most of the cases as we applied on the different given images the algorithm works well and it enhanced the gray images. The adaptive transformation function distributes the intensity so that the given image contains the bin having less zero value. The given images is taken from [10]



(a) (b) (c)



(d) (e)

Figure 4.5: (b) Equalize histogram, (b) 2DHE, (c) APLT,(d) BPDHE, (e) RMHE with respective histogram.

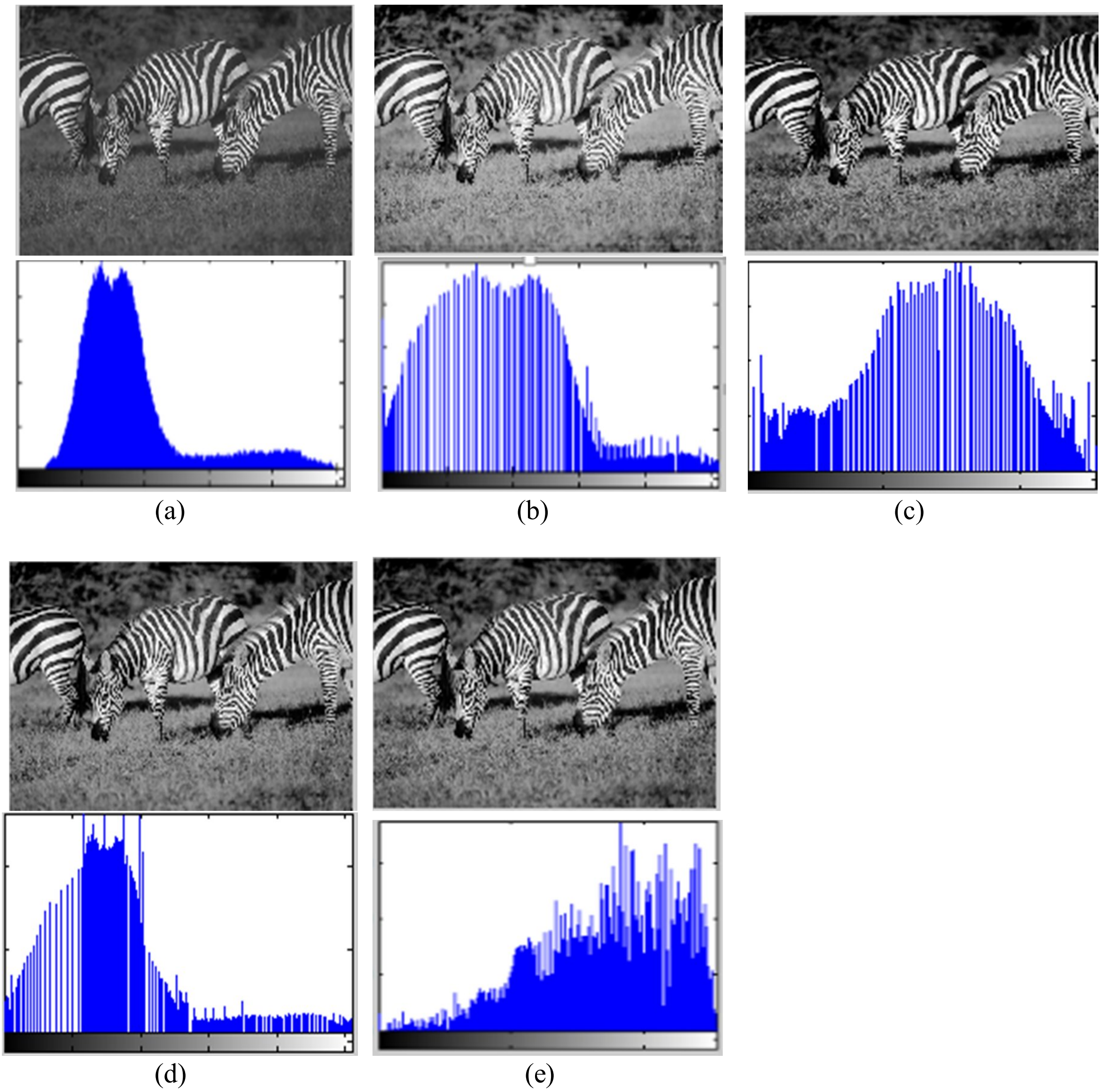


Figure 4.6: (a) Equalize histogram, (b) 2DHE, (c) APLT, (d) BPDHE, (e) RMHE with respective histogram.

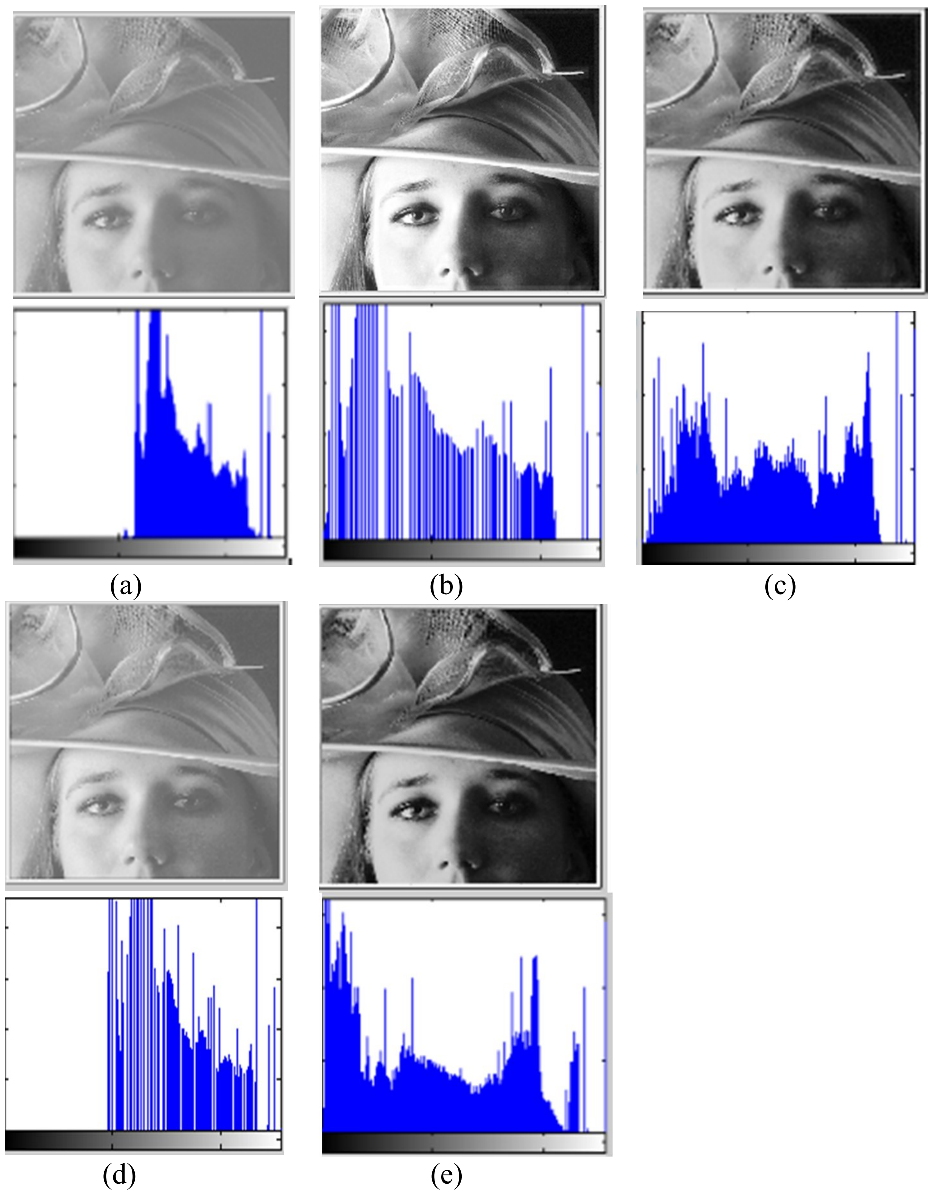


Figure 4.7: (a) Equalize histogram, (b) 2DHE, (c) APLT, and (a1), (b1), (c1) are the respectively histogram of an image.

Quantitative Measurement:

In order to assign visual assessment score to each enhanced images a subjective method quality test are performed on the three different algorithm on the result of enhanced images. For each test on the enhanced image a subjective score is shown in given table. The subject is then asked to provide the quality assessment score by assigning the real number value, if the value is higher the image quality is higher i.e. more enhanced image. As we can see the in the table CMN quality measurement is applied to the six different images produced by the histogram equalization, two dimensional histogram equalization and adaptive power law transformation. For images the respective score value is shown, as we can see the score value for histogram equalization is lower as compared to the other algorithm applied and the in some cases the score value of two dimensional histogram is more than the adaptive power law transformation but it near to the proposed algorithm. As the CMN is used to measure the contrast of an image, the contrast score value is given in the table and we can tell the contrast of an enhanced image. The overall CMN [13]values is also shown as average of all values. The CMN values is calculated by taking the same window size for all algorithm.

The output image i.e. the processed image, is consider to be enhanced for the given image if it enables the image details to be better view. Information in the input image should be conserved in the output image. The output image given by the algorithm is quantified according to a standard measurement which combines discrete entropy together with measurement of contrast. The discrete entropy (DE) [11] of the given image A with n distinct gray-level is:

$$??(?) \quad -\sum_{???}^{?} ?Æ_{?} \;\; ??? \; ?(?_{?}) \qquad (8)$$

Where p(? ?) probability of pixel intensity ? ? which is estimated from the normalized image histogram. The discrete entropy (DE) of the output image B with n distinct gray-level is:

? ? (?) −∑? ? ? ? ? (? ?)?? ? ? (? ?) (9)

Where p(? ?) probability of pixel intensity ? ? which is estimated from the normalized output image histogram. The higher value of DE shows the image has richer details. The edge based contrast measure (CM) is placed on the observation that the human recognition mechanism are sensitive to edges [12]. The contrast C(i, j) for the pixel of an image A having coordinate at (i, j) is defined as:

? (? ?) |? (? ?)? ? (? ?)| / |? (? ?)? ? (? ?)| ÆÈ

Where the mean edge grey level is:

? (? ?) ∑Æ ? ϵ? Æ ? ? (? ?)? Æ ? ∑Æ ? ϵ? Æ ? ? (? ?) (11)

N(i,j) is the neighboring pixels in the window and g(n, l) is the edge value at position (n,l). CM for the given image A is computed as the average contrast value.

? ? (?) ∑? ?? ? ∑? ?? ? ? Æ ? ? ? (12)

The contrast C(i, j) for the pixel of an output image B having coordinate at (i, j) is defined as:

? (? ?) |? (? ?)? ? (? ?)| / |? (? ?)? ? (? ?)| ÆÈÊ

Where the mean edge grey level is

? (? ?) ∑Æ ? ϵ? Æ ? ? (? ?)? Æ ? ∑Æ ? ϵ? Æ ? ? (? ?) (14)

. N(i, j) is the neighboring pixels in the window and g(n, l) is the edge value at position (n, l). CM for the given image B is computed as the average contrast value.

$$?? \ (?) \quad \sum_{?? ?}^{?} \sum_{?? ?}^{?} ? Æ ? \quad ?? \qquad (15)$$

Table 1: Quantitative Measurement results as ?? ? :

Image	HE	2DHE	APLT	BPDHE	RMHE
Girl	0.0197	0.2973	0.2318	0.2106	0.1985
Zebra	0.0260	0.3269	0.3567	0.3125	0.0369
Street	0.1908	0.2928	0.2730	0.2169	0.1052
Home	0.0926	0.1276	0.1189	0.1026	0.0912
Bridge	0.0198	0.1245	0.1295	0.1145	0.0127
Boat	0.2495	0.3609	0.2918	0.2587	0.2985
Average	0.0997	0.2550	0.2336	0.2125	0.1983

Table 2: Quantitative Measurement results as ?? ? :

Image	HE	2DHE	APLT	BPDHE	RMHE
Girl	0.4623	0.4815	0.4791	0.4769	0.4638
Zebra	0.4920	0.4990	0.4901	0.4869	0.4931
Street	0.4880	0.4950	0.4895	0.4798	0.4698
Home	0.4502	0.4866	0.4847	0.4859	0.4519
Bridge	0.4532	0.4670	0.4843	0.4812	0.4569
Boat	0.4528	0.4767	0.4812	0.4802	0.4612
Average	0.4664	0.4843	0.4848	0.4711	0.4698

Chapter 3

CONCLUSION AND FUTURE WORK

The proposed algorithm is an adaptive image enhancement algorithm. The proposed algorithm can be apply to both gray-level and color images. The proposed algorithm can also be applied to the medical image enhancement. Performance comparison enhancement algorithm shows that the proposed algorithm produce satisfactory enhancement even under the diverse illumination condition.

The size of the window i.e. square neighborhood around each pixel determines the performance of the given algorithm. The proposed algorithm is simple and effective for contrast enhancement. It requires a small number of simple calculation to generate the contrast enhancement image. Thus it can applied in real time application that require image contrast enhancement while retaining overall image content.

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