# Image Enhancement Technique using Adaptive Gamma Correction and Weighting Distribution Function

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***Abstract:*** **The paper aims to present an efficient method which enhances the dimmed images. As in today's technology enhancement is the key factor in many fields of digital image processing. It has totally emerged as a different branch in image processing. In many fields there is a need to enhance the image to extract the hidden data in image. This paper accounts this issue of enhancing the dimmed images by making use of AGCWD (Adaptive Gamma Correction with Weighting Distribution function) technique. The video sequences are modified by making use of Temporal Based (TB) technique. These both techniques improve the video and images, such that the effects are desirable and results are suitably accurate compared to the other given methods. Experimental shows that the proposed technique enhances images and videos of better quality & the time consumption is very less as compared to the other methods.**

***IndexTerms*** **- Digital image processing, Image Enhancement, Histogram equalization, Gamma Correction.**

## I. INTRODUCTION

Image enhancement techniques have been extensively used in many applications of image processing where the subjective quality of image is important for human interpretation. Poor contrast in images and video sequence are mainly because of luminance, brightness, unfavorable weather conditions, devices, acquisition of environment, indoor lighting etc. These are all not under the favor of human beings. But we need these images to be visible properly and the information present in the images to be retrieved as it is.

Image processing is a branch, where some operations are performed on images, to obtain the better results from original image. There are lots of techniques developed to enhance brightness, normalize gray levels, analyzing gray levels, detecting noise, removal of noise etc. It is the rapidly growing branch, with its applications involving in every field. The core research area of image processing is within engineering and computer science. Many algorithms for accomplishing enhancement have been developed and applied to problems in image processing.

Image enhancement plays an important role in retrieving the information content of the image. Various techniques and methods have been applied to enhance the images and videos. It has become a branch of Image Processing, where it has become a desire to produce better and better results in image enhancement.

The main scope of enhancement is to process an image so that the result produced is better than the original image for any specific application. For example, a method that is quite useful for enhancing normal images may not necessarily be the efficient method for enhancing pictures of X-ray images.

### 1.1 Problem Definition

The project aims to propose productive method to modify histograms and enhance contrast in digital images. Enhancement plays a significant role in digital image processing and pattern recognition. For enhancing the video sequence, the proposed image enhancement method makes use of Temporal based technique to reduce the computational complexity required to enhance a video sequence.

Project deals on enhancement of image and video by using the proposed AGCWD method for image enhancement and TB method for video enhancement. By using the TB technique it reduces the computational complexity required to enhance the video sequence. Experimental results shows that the given method enhances images and videos according to the given image, that is, it enhances only those regions where the enhancement is required, no enhancement is done where it does not require.

## II. Literature Survey

This section deals with some of the existing techniques, a survey of the work carried out in the domain of contrast enhancement techniques. There are several methods involved in enhancing video sequence and images , among the different methods involved some of the methods which helped in development of the proposed method are THE method, BBHE method, RSIHE method and RSWHE method. These listed methods are discussed briefly in the below following section.

### 2.1 THE method

It is the most widely used method in many of the image enhancement applications. The acronym of THE stands for Traditional Histogram Equalization method. It is the most effective enhancement technique of the contrast images. It makes use

of the cumulative density function of the image such that, the values of the pixels are uniformly distributed. It stretches the high histogram regions and compresses the low regions. This results in enhancing the images globally. While enhancing the images it introduces two annoying artifacts and undesirable enhancement of the image. One is the loss of contrast for the images with less frequent gray levels and enhancement of image regions with more frequent gray levels, which basically leads to the loss of original brightness of the image. To overcome these drawbacks and to preserve the brightness of the image other methods are proposed.

The below fig(2.1) shows the histogram of an image and the histogram which is obtained after passing through the THE method.

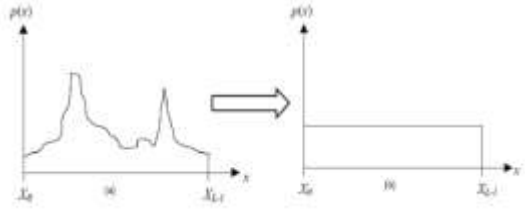


Fig 2.1: (a) Histogram of an image. (b) Histogram after passing through THE method.

**2.2 BBHE method**

The BBHE method is used to preserve the mean brightness of the image. The acronym of BBHE stands for Brightness Preserving Bi-Histogram equalization. This method is proposed to overcome the drawback proposed in THE method. The contrast is enhanced in such a way that brightness of the image retained at some extent. This method decomposes the given image into two sub images. Separate histograms are obtained for the given two sub images. Then applying the Histogram Equalization method on each separate histogram. The result of this method produced is, an image with brightness value located at mean of the image. This technique is a hybrid approach between clipped histogram equalization method with mean brightness preserving histogram equalization method. It shows better result as compared to THE method.

In the below fig 2.2 (a) shows the histogram of the image which is divided into two sub divisions and (b) shows the equalized histogram for separate divisions.

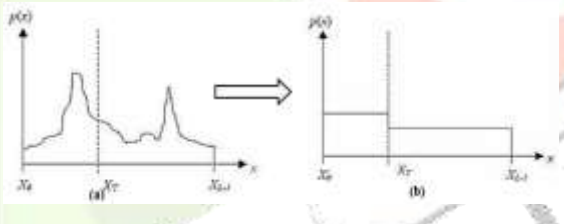


Fig 2.2: (a) Histogram of an image. (b) Equalized histogram for an image.

**2.3 RSIHE method**

This technique is used for preserving the brightness of the image. The acronym of RSIHE stands for Recursive Sub-Image Histogram Equalization. Basically it is applied for dimmed images. To get better results than the DSIHE method, this method divides the image recursively. This technique focuses on the median values of the image and recursively divides the image into multiple segments and then apply the histogram equalization method on each segment. The multi-equalization method is applied to each histogram to reduce the generation of unfavourable artifacts. It produces better results as compared to the previous method. But if the image is brighter then it leads to the over enhancement of the image.

In the below fig 2.3 (a) shows the histogram of the image which is divided into multiple divisions and (b) shows the equalized histogram for separate divisions.

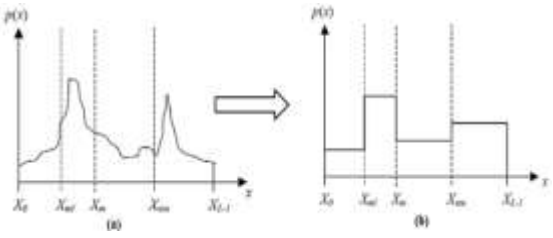


Fig 2.3: (a) Histogram of an image. (b) Multiple Equalized histogram for an image.

**2.4 RSWHE method**

The acronym of RSWHE stands for Recursive Separated and Weighted Histogram Equalization. It consists of three modules; they are Histogram Segmentation, Histogram Weighting and Histogram Equalization. In the first module, it takes the input image and computes the histogram for the given image. It recursively divides the input histogram into two or more sub histograms. In the second module, it modifies the histogram based on the normalized power law function. In the last module, the histogram equalization method is run on each of the modified sub histograms. It mainly preserves the effective brightness for the dark images.

The below figure is a functional representation of RSWHE method.

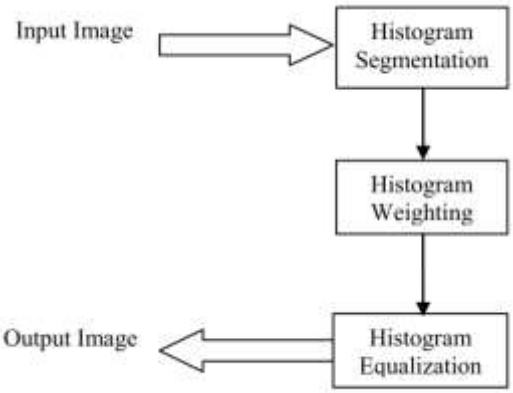



Fig 2.4: Functional representation of RSWHE method

***Histogram Segmentation Module*:** Splits the image into two or more sub histograms.

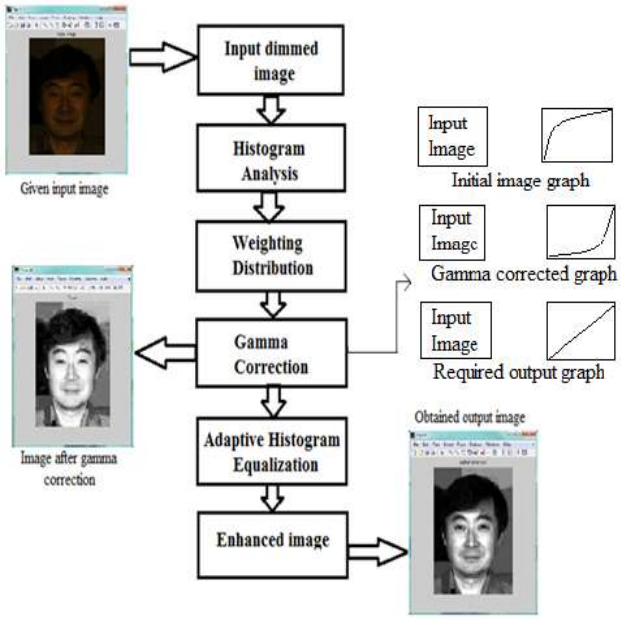
***Histogram Weighting Module*:** Changes the histogram based on the weighting function and applies the normalized power law to the image.

***Histogram Equalization Module*:** Equalizes the modified sub histograms.

**III. Proposed Method**

To compensate for the limitations of these methods, a technique must be developed which creates a balance between high levels of visual quality and low computational costs. In this paper, a hybrid HM method is proposed to accomplish this goal by efficiently combining the AGC and THE methods. As indicated in the description of the RSWHE method, a normalized gamma function can be used to modify each sub-histogram to include multi-equalizations with brightness preservation. However, the modified sub-histograms might lose some statistical information, thus reducing the effect of enhancement. Inspired by the RSWHE method we directly utilized cdf and applied a normalized gamma function to modify the transformation curve without losing the available histogram of statistics. Consequently, the lower gamma parameter generates a more significant adjustment. This observation led us to employ a compensated cdf as an adaptive parameter, which modifies the intensity with a progressive increment of the original trend. The proposed adaptive gamma correction (AGC) is formulated as follows:

$$T(l)=lmax(l/lmax)\gamma=lmax(l/lmax)1-cdf(l).$$




Flowchart for AGCWD method to enhance images.

The block diagram for image enhancement consists of five phases. Each of these is explained briefly below.

***Histogram Analysis****:* In this phase, a graphical plot of frequency of gray levels to the intensities of each pixel is calculated for the given input image.

***Weighting Distribution****:* In this phase, analysis of the histogram is done. According to the histogram slight modifications are done to it, so that it should lessen the generation of unfavourable artifacts in the image.

***Gamma Correction****:* In this phase, de-gamma function is applied to the image so that the output is exactly the same as the given input. This phase is briefly discussed in next chapter.

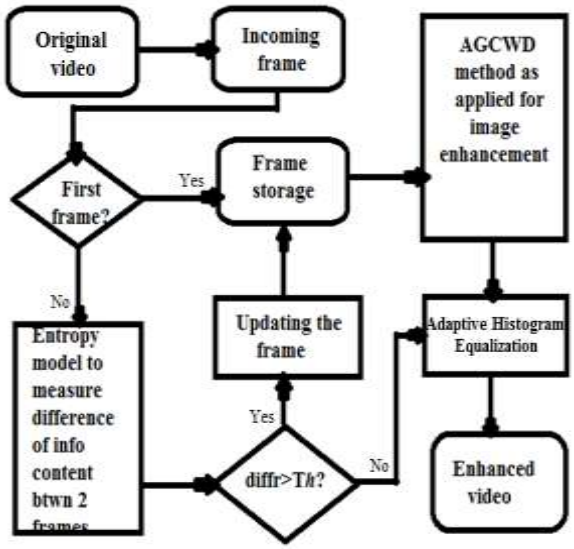
***Adaptive Histogram Equalization****:* Here the high intensities are equalized and low intensities are kept as it is, that's according to the given intensities of image.

***Enhanced Image:*** In this phase, the output for the input image is produced.

In addition to image-contrast enhancement, we also propose a temporal-based (TB) technique to further reduce the computational complexity required by the AGCWD method to enhance a video sequence. Figure below shows the flowchart of the TB method as applied for video-contrast enhancement. At the beginning of the process, the first incoming frame is directly stored in the frame storage, which is used to generate a mapping curve for the proposed AGCWD method. For subsequent incoming video frames, the entropy model can be used to measure the differences of the information content between two successive frames. The information content of each frame is approximated by the following entropy formula:

$$H = -lmax⁡=0pdf(l)log(pdf(l)).$$

If the difference is found to be more than the given threshold value, then the current frame is updated to the frame storage. The standard threshold value is set to 0.05. If the difference is below threshold value then, generated mapping curve is applied for the frame. Then it is next passed through the AGCWD method, which is used for enhancing the image. Lastly the image enhancement function is applied to the frame.




Flowchart for Temporal Based (TB) method, to enhance video sequence.

The block diagram of enhancing video sequence consists of the below phases, which are explained briefly.

***Original video:*** This is the first phase of video enhancing. It loads the video sequence to be enhanced. Mostly the videos to be enhanced are those where the information content is lost in the video sequence.

***Incoming frame:*** In this phase, the input video is divided into frames. So that in future phases, the enhancement of video is done properly without generating artifacts in the video.

***Entropy model:*** This phase is used to measure the difference in information content between the two successive frames of the given video. If the difference is greater than the given threshold (i.e. 0.05 standard value) value then the frame storage is updated by the current frame. And for this frame mapping curve is generated, which is applied before applying the AGCWD method to reduce the computational complexity and time.

***AGCWD:*** Frame is a part of the video sequence. Running multiple number of frames simultaneously consist the video sequence. Applying AGCWD method to each frame, which is the same method applied for image enhancement.

***Enhancement:*** This phase enhances the video by using the mapping curve generated at the third phase of this method. This basically reduces the time and computational complexity as required by the other methods.

**IV. Experimental Results**

This section summarizes the experimental results produced by the AGCWD method for image enhancement and TB method for video enhancement. The results are simulated by using the MATLAB software of version 2013.

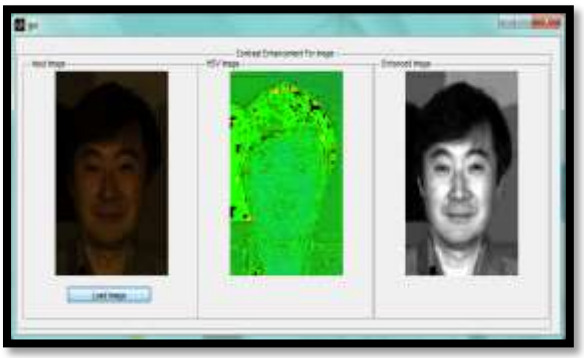


Fig: Simulation results for image enhancement by using AGCWD method.

Fig: Simulation results for video sequence by using TB method.

The quantitative evaluations assessed via AMBE and 纫E94 are listed in below Table. The results indicate that the proposed method produced enhanced images are with the lowest distortion. This is due to an achievement of balance between enhancement of contrast and preservation of image features.

| | Existing system | | Proposed system | |
|---|---|---|---|---|
| Video No. | AMBE | E94 | AMBE | E94 |
| 01 | 0.01489 | 0.04753 | 0.01634 | 0.05088 |
| 02 | 0.01267 | 0.05665 | 0.02371 | 0.10875 |
| 03 | 0.07855 | 0.2414 | 0.08041 | 0.24982 |
| 04 | 0.01674 | 0.04565 | 0.04066 | 0.12254 |

Table: Comparison of existing and proposed system.

Calculated results shows that proposed method efficiency is greater than the existing method. Greater the value of AMBE and .E94 indicates that the brightness and quality of the video sequences is preserved.

**V. Conclusion**

The paper presents an efficient enhancement technique which is used for enhancing dimmed images and videos. In the enhancement of image, we focus on enhancing the dimmed part of the image. The technique follows the AGCWD method, which is very efficient. It has three phases. In the first phase analysis of histogram is done. Next Weighting Distribution function is used on the histogram to reduce the generation of unfavourable effects on the image. In the last phase Gamma Correction is applied, this is used to alter the visual effects on the output screen. This is very important phase as the image which is required to produce; it will not be presented due the variations in input and output image. Because of this the given method is very efficient.

For the video sequence, the TB method is used. This method reduces the time and computational complexity. It focuses on each frame and enhances according to the given frame. And it will enhance only those parts which are required to be enhanced. This method makes use of entropy model, which is used to calculate the difference between the current and the previous frame. By using this it is able to enhance the video sequence uniformly. It is also capable of reducing the generation of undesirable effects which distort the video sequence. It produces the sequence which is more suitable to observe and has a video quality as that of the given video. This method can be applied in real- time environment with given limited available number of resources. And within the less time the video is enhanced. Both the methods are efficient in enhancing video and images.

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