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Effective Contrast Enhancement using Adaptive Gamma Correction and Weighting Distribution Function

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ABSTRACT: This paper proposes an efficient technique to adjust histograms and upgrade contrast in advanced pictures. Improvement assumes a significant part in advanced picture handling and PC vision. We show a programmed change strategy that enhances the shine of diminished pictures by means of the gamma correction and likelihood circulation of luminance pixels. To upgrade video, the proposed picture improvement technique utilizes transient data with respect to the contrasts between every edge to lessen computational unpredictability. Exploratory results exhibit that the proposed strategy produces improved pictures of equivalent or higher quality than those created using past techniques.

Key Words: Contrast enhancement, Histogram modification, 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, unfavourable weather conditions, devices, acquisition of environment, indoor lighting etc. These are all not under the favour 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.

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.

This paper 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.

Scope of the paper. The specific scope of the present work is to produce an image which is comparatively better than the original image and we will be able to find the minor details of image which were not visible in the original image. It is helpful in the fields like medical image processing, radar image processing, pattern recognition etc.

The paper aims to

-To enhance the dimmed image by making use of proposed method that is AGCWD method.

-This method is very useful as it can enhance colour image without generating artefacts or distorting the colour.

-To enhance the video the proposed method makes use of temporal based technique which reduces the time and computational complexity to enhance the video sequence.

Paper Summary. This section quickly depicts about prologue to Image handling and diverse procedures accessible to enhance pictures and recordings. It likewise clarifies about issue definition, extension and destinations of the undertaking. Section 3 manages writing overview which clarifies about the past techniques and spotlights on their primary components of the strategies. Outline and flowchart of the techniques has been clarified in section 4. Section 5 manages the simulation results. Section 6 manages Results and discussions. General conclusions from this theory and conceivable expansions are exhibited in section 7.

II. LITERATURE SURVEY

This section specifies some of the existing techniques, a review of the work completed by scientists in the area of differentiation improvement systems. The study of papers is done to know the current procedures being utilized for improving darkened pictures and upgrading the video grouping.

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, DSIHE method, RSWHE method and RSIHE method. These listed methods are discussed briefly in the below following section.

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 elevated histogram segments and compresses the small regions. This results in enhancing the images globally. While enhancing the images it introduces two annoying artefacts and undesirable enhancement of the image. One is the loss of contrast for the images with a lesser amount of recurrent gray levels and enhancement of image regions with extra frequent gray levels, which basically leads to the loss of original brightness of the image. To overcome these drawbacks and to conserve the brightness of the image other methods are proposed.

BBHE method. The BBHE method is used to maintain the mean brightness of the image. The acronym of BBHE stands for "Brightness Bi-Histogram Equalization". The method is anticipated to prevail over the drawback proposed in THE method. The contrast is improved in such a way that clarity of the image retained to some extent. This method decomposes the original image into two different sub images. Two different histograms are obtained for the given two sub images. Then applying the Histogram Equalization method on given each separate obtained 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 methods with mean brightness preserving histogram equalization method. It shows better result as compared to THE method.

DSIHE method. This technique is mostly used for retaining the information content of the image. The acronym of DSIHE stands for "Dulastic Sub Image Histogram Equalization". This method is expected to work in same way as the BBHE method except that DSIHE separates the image based on the maximization of Shannon's entropy of resulting image. Between the two separate parts, one part consists of bright and the other consists of the dark. The result obtained is a combination of these two sub-images into a single image. It produces better enhancement result but it reduces the equalization effect of the image. It is not suitable for over-equalization effect problem, if the particular image has high distribution of density in narrow range.

RSIHE method. This technique is used for retrieving the brightness of the image. The acronym of RSIHE stands for "Recursive Sub Image Histogram Equalization". On the whole 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 artefacts. 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.

RSWHE method. The acronym of RSWHE stands for "Recursive Separated and Weighted Histogram Equalization". It comprises of three brief areas; they are Histogram Segmentation, Histogram Weighting and Histogram Equalization. In the primary section, it takes the predefined unique picture and creates the histogram for the given picture. It ceaselessly separates the histogram of information picture into two or more histograms. In the second stage, it changes the histogram taking into account the standardized force law capacity. In the last portion, the histogram balance strategy is keep running on each of the altered separate histograms. It predominantly safeguards the compelling splendour for the dim pictures. The below figure is a functional representation of RSWHE method.

Histogram Segmentation Module: It is the first phase, where it splits the image into two or more histograms.

Histogram Weighting Module: This stage changes the histogram taking into account the weighting work and applies the standardized force law to the picture.

Histogram Equalization Module: This stage evens out the altered sub histograms.

III. PROPOSED METHOD

The Proposed method consist of the AGCWD method for image enhancement and Temporal based method for video sequence enhancement. These both methods are discussed briefly below.

AGCWD Method. The acronym of AGCWD method stands for Adaptive Gamma Correction with Weighting Distribution. It mainly specifies, making use of Gamma Correction and Weighting Distribution function in such a way that the functions are adjusted according to the given image.

The AGC (Adaptive Gamma Correction) is formulated a

$$I'(l) = l_{\max}(l/l_{\max})^{\gamma} = l_{\max}(l/l_{\max})^{1-cdf(l)}.$$

In the above equation the gamma parameter is modified as below.

$$\gamma = 1 - cdf_w(l).$$

This formula is applied to the given input image to maintain the gray levels of the image. If the image contains low level intensities, these are progressively increased. And if the image contains high level intensities, it will avoid the significant decrement in these intensities.

The Weighting Distribution function is given by

$$pdf_w(l) = pdf_{\max}\left(\frac{pdf(l) - pdf_{\min}}{pdf_{\max} - pdf_{\min}}\right)^{\alpha}$$

In the above function α is the adjusted parameter. The given $pdf_{\max}$ is the highest pdf of the given statistical histogram. And the $pdf_{\min}$ is the least pdf of the histogram.

Form on the above equation, the customized *cdf* is given by

$$cdf_w(l) = \sum_{l=0}^{l_{\max}} pdf_w(l) / \Sigma pdf_w$$

Where the sumasation of *pdf*w is calculated as below

$$\Sigma pdf_w = \sum_{l=0}^{l_{\max}} pdf_w(l).$$

As mainatined from the studies in literature survey, color images can be adopted to human naked eyes by enhancing the HSV model of color. The HSV color model is used to characterize the precise colors in some paradigm, which is usually acknowledged. It represents the Hue(H), Saturation(S) and Value(V) of the images. The color content Hue and Saturation discribes the color substance of the image where as the value represents the luminance brightness of the image. If we need to enhance the image then we need to preserve the V content of the HSV model. The H and S content need to be maintined as it is and focus is on only V compinent of the color model. The main aim is to preserve the V content of image. Hence the proposed method makes use of HSV color model to pull out the V component from the image.

Below is a flowchart for the proposed AGCWD method.

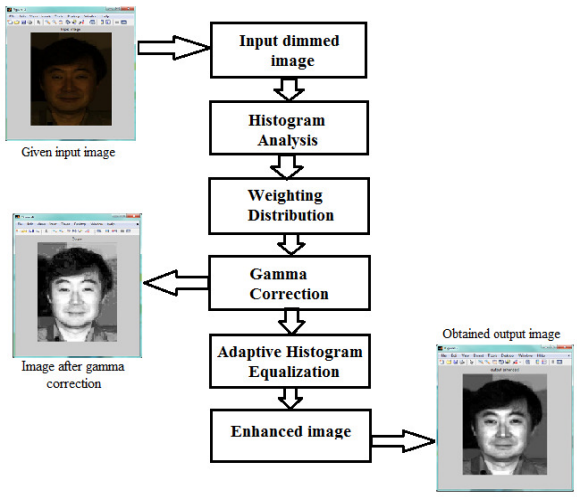

Fig. 1. Flowchart for AGCWD method, to enhance image.

Temporal Based Method. This method is used for enhancing the video sequence. The method intends to decrease the computational complexity and time essential by the AGCWD method for modifying the video sequence such that, the content is more to visualize.

The process starts with the splitting of video sequence into frames. Frames are the part of video. Number of frames combines to form the video sequence. Each frame can be considered as an image. The first arriving frame is kept in frame storage. For this frame a mapping curve is generated, which is used to decrease the computational time for the subsequent arriving frames. For the other incoming frames, the entropy is calculated. It is used for measuring the absolute variation among the current frame and the previous frame. The difference is calculated by the below formula

$$H = -\sum_{l=0}^{l_{\max}} pdf(l)\log(pdf(l)).$$

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.

Below shown is a flowchart for TB method.

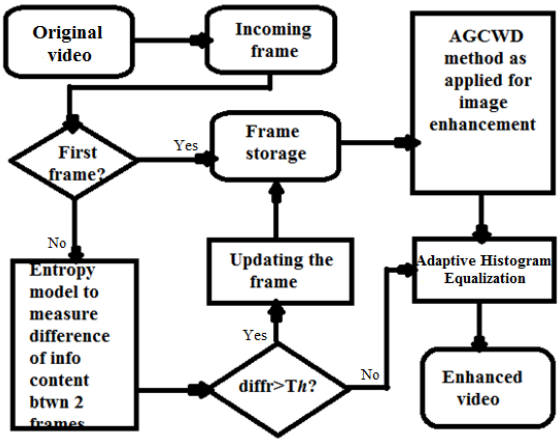

Fig. 2. Flowchart for TB method, for enhancing video sequence.

IV. SIMULATION RESULTS

To check whether the quality of the video is retained, the project has used the two parameters which are used for measuring the quality of the video sequence. The parameters are AMBE and E94 values.

Table 1: AMBE & E94 Values.

	Existing system		Proposed system	
Vidco 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

AMBE is the Absolute Mean Brightness Error. It describes the differentiation between the given original video and the enhanced video, the difference produced should not be much. For the proposed and existing system, the AMBE and E94 values are computed. The simulation results are calculated using the MATLAB version 2013 software. The below is a table which shows the values for AMBE and E94 for these methods.

V. CONCLUSIONS

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 as compared to other methods. 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 is efficient as compared to other given methods because of the reduced time and computational complexity. This method 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 estimate the variation among 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 proposed technique can be useful in the given surroundings with specified restricted existing 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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