RESEARCH ARTICLE OPEN ACCESS

Color Sensitive Adaptive Gamma Correction for Image Color and Contrast Enhancement

Asha M1, Jemimah Simon2
1Asha M Author is currently pursuing M.Tech (Information Technology) in Vins Christian College of Engineering, e-mail: aashapanickar@gmail.com.
2Jemimah Simon Author is currentlyworking as Assistant Professor of IT department in Vins Christian College of Engineering.

Abstract:
The proposed system uses an efficient method for contrast and color enhancement of digital images. The contrast of image is very important characteristic by which the quality of image can be judged as good or poor quality. Also Enhancement of image plays a significant role in digital image processing, computer vision, and pattern recognition. Here, an automatic transformation technique that improves the brightness of dimmed images via the gamma correction and probability distribution of luminance pixels is proposed. The proposed method is composed of three major steps. First, the histogram analysis provides the spatial information of a single image based on probability and statistical inference. In the second step, the weighting distribution is used to smooth the fluctuant phenomenon and compute histogram stretching threshold. In the third and final step, Adaptive gamma correction and Adaptive Histogram Stretching with respect to color constraint can automatically enhance the image contrast and color through use of a smoothing curve. Proposed technique performs efficiently in different dark and bright images by adjusting their contrast very frequently. The proposed method produces enhanced images of comparable or higher quality than conventional method.
Keywords Contrast enhancement, Gamma correction, Histogram equalization, Histogram Stretching.

I. INTRODUCTION

Contrast enhancement plays an important role in the improvement of visual quality for computer vision, pattern recognition, and the processing of digital images. Poor contrast in digital video or images can result from many circumstances, including lack of operator expertise and inadequacy of the image capture device. Unfavorable environmental conditions in the captured scene, such as the presence of clouds, lack of sunlight or indoor lighting, and other conditions, might also lead to reduced contrast quality. Essentially, if the overall luminance is insufficient, then the details of the image or video features will be obscured.

In general, the enhancement techniques for dimmed images can be broadly divided into two categories: direct enhancement methods and indirect enhancement methods. In direct enhancement methods, the image contrast can be directly defined by a specific contrast term.

Conversely, indirect enhancement methods attempt to enhance image contrast by redistributing the probability density. In other words, the image intensities can be redistributed within the dynamic range without defining a specific contrast term. Histogram modificationtechniques are the most popular indirect enhancement techniques due to their easy and fast implementation.

Gamma correction techniques make up a family of general HM techniques obtained simply by using a varying adaptive parameter γ. The simple form of the transform-based gamma correction is derived by

$$T(l) = l\max(l / l\max)^{\gamma} \quad (1)$$

Where l_{max} is the maximum intensity of the input. The intensity of each pixel in the input image is transformed as T(l) after performing. As expected, the gamma curves illustrated with γ> 1 have exactly the opposite effect as those generated with γ< 1, as shown. It is important to note that gamma correction reduces toward the identity curve when γ = 1.

Howeverwhen the contrast is directly modified by gamma correction, different images will exhibit the same changes in intensity as a result of the fixed parameter. Fortunately, the probability density of each intensity level in a digital image can be calculated to solve this problem. The probability density function can be approximated by

$$pdf(l) = n1/(MN) \quad (2)$$

Where $n_l$is the number of pixels that have intensity l and MN is the total number of pixels in the image. The cumulative distribution function is based on pdf, and is formulated as:

$$cdf(l) = \sum_{k=0}^{l} pdf(k) \quad (3)$$

After the cdf of the digital image is obtained Traditional Histogram Equalization directly uses cdf as a transformation curve expressed by

$$T(l) = cdf(l)l\max \quad (4)$$

It is important to note that the transformation of theTHE method degrades toward the identity line when pdf is the most uniform with maximum entropy. Various disadvantages exist in regard to the TGC and THE methods show the modified values of each intensity by using the corresponding curves illustrated. The x-coordinate is the input intensity and the y-coordinate is the decrement or increment of each intensity level. As shown, unvaried modification s produced by the use of the TGC method with a pre-defined parameter. On the other hand, the method uses the property of the histogram to enhance the intensity contrast; this inappropriate modification is shown.

Over-enhancement and under-enhancement are indeed major challenges due to the unnatural changes in cdf. For example three areas are circled that point out these adverse effects: some low intensity levels are still decreased, moderate intensity levels are significantly increased, and high intensity levels are significantly decreased. This project proposes an efficient algorithm for contrast and color enhancement of digital images. The contrast of image is very important characteristics by which the quality of image can be judged as good or poor quality. Also Enhancement of image plays a significant role in digital image processing, computer vision, and pattern recognition. n automatic transformation technique that improves the brightness of dimmed images via the gamma correction and probability distribution of luminance pixels. The proposed method is composed of three major steps. First, the histogram analysis provides the spatial information of a single image based on probability and statistical inference. In the second step, the weighting distribution is used to smooth the fluctuant phenomenon and compute histogram stretching threshold. In the third and final step, Adaptive gamma correction with respect to color constraint can automatically enhance the image contrast and color through use of a smoothing curve. Also temporal information is used to reduce the computational time for several image frames of a video sequence. Proposed technique performs efficiently in different dark and bright images by adjusting their contrast very frequently. Proposed technique is very simple and efficient approach for contrast and color enhancement of image. The proposed method produces enhanced images of comparable or higher quality than conventional method.

II. RELATED STUDIES

The Brightness-preserving Bi-Histogram Equalization method calculates the mean intensity as the threshold value [3], while the Dualistic Sub-Image Histogram Equalization method uses the median instead of the mean [4].The Brightness-Preserving HistogramEqualization with Maximum Entropy method preserves the brightness and also maximizes the entropy of the enhanced image via histogram speciation [5]. After segmentation overlaps the sub-blocks of the image, the THE method should be employed several times to enhance the local contrast per block. To reduce the computational cost Cascaded Multistep Binomial Filtering Histogram Equalization was utilized in order to achieve the same low-pass filter mask [3]. However, its time complexity is still much higher than BBHE and DSIHE.The Recursive Sub-Image Histogram Equalization method features the same time complexity, but extends DSIHE by including multi-equalizations to reduce the generation of artifacts [2].

However, this problem cannot be effectively solved by using its recursive nature and scalable brightness preservation techniques. In addition to histogram separation techniques, the Recursively Separated and Weighted Histogram Equalization method uses a weighting function to smooth each sub-histogram for image enhancement as well as brightness preservation.

As the original histogram is subject to the brightness constraint the Flattest Histogram Specification with Accurate Brightness Preservation method utilizes convex optimization. In order to concurrently apply TGC and THE, the Dynamic Contrast Ratio Gamma Correction method directly sets a parameter as a ratio. However, it cannot be automatically generated.

Contrast enhancement can be optimized by the histogram modification framework which incorporates penalty terms for histogram deviation as well as minimizes a cost function to compute a target histogram [1]. In order to accurately preserve brightness, the Automatic Weighting Mean-separated Histogram Equalization method uses the recursive function to optimize the threshold values applied to equalize sub-histograms. The aforementioned techniques use only a one-dimensional histogram even if it might possess spikes which compress other gray-levels for distribution.

To alleviate the previously discussed problem, the two-dimensional histogram is used to generate contextual and variational information in the image [4], while the Gaussian Mixture Model can also be used to compensate for the gray-level distribution of the image. The Contextual and Variational Contrast enhancement method is more effective at showing the visual quality of the image, because it directly constructs an a priori probability, which further represents details of the image [2]. However, the CVC method requires a high level of computation when increasing the gray-level differences between neighboring pixels.

A. Histogram modification

In this framework, contrast enhancement is posed as an optimization problem that minimizes a cost function. By introducing specifically designed penalty terms, the level of contrast enhancement can be adjusted; noise robustness, white/black stretching and mean-brightness preservation may easily be incorporated into the optimization. [1]Analytic solutions for some of the important criteria are presented.

B. Novel fuzzy logic approach

In this paper, we will use maximum fuzzy entropy principle to map an image from space domain to fuzzy domain by a membership function, and then apply the novel, adaptive, direct, fuzzy contrast enhancement algorithm to conduct contrast enhancement.

C. Adaptive unsharp masking

This paper presents a new method for unsharp masking for contrast enhancement of images. Our approach employs an adaptive filter that controls the contribution of the sharpening path in such a way that contrast enhancement occurs in high detail areas and little or no image sharpening occurs in smooth areas.

III. PROPOSED METHOD

The proposed system uses an efficient method for contrast and color enhancement of digital images. The contrast of image is very important characteristics by which the quality of image can be judged as good or poor quality. First, the histogram analysis provides the spatial information of a single image based on probability and statistical inference. Also Enhancement of image plays a significant role in digital image processing, computer vision, and pattern recognition. Here present an automatic transformation technique that improves the brightness of dimmed images via the gamma correction and probability. In the second step, the weighting distribution is used to smooth the Fluctuant phenomenon and compute histogram stretching threshold. In the third and final step, Adaptive gamma correction with respect to color constraint can automatically enhance the image contrast and color through use of a smoothing curve. 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.

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. Finally, the gamma parameter based on cdf of Equation is modified as follows:

$$\gamma = 1 - cdfw(l) \quad (5)$$

According to studies and , color images can be enhanced to be acceptable to human vision by using the HSV color model, which can decouple the achromatic and chromatic information of the original image in order to maintain color distribution. In the HSV color model, the hue and the Saturation can be used to represent the color content, with the value representing the luminance intensity. The color image can be enhanced by preserving H and S While enhancing only V. Hence, the proposed AGC with WD method was applied to the V component for color contrast enhancement. The color image can be enhanced by preserving H and S While enhancing only V. Hence, the proposed AGC with WD method was applied to the V component for color contrast enhancement.

A. Preprocessing

RGB image should be converted into Lab that takes red, green, and blue matrices, or a single m x n x 3 image, and returns an image in the CIELAB color space. RGB values can be either between 0 and 1 or between 0 and 255. Values for L are in the range [0,100] while a and b are roughly in the range [-110,110].

B. PDF analysis

A probability density function is a function that describes the relative likelihood for this random variable to take on a given value. The probability of the random variable falling within a particular range of values is given by the integral of this variable's density over that range that is, it is given by the area under the density function but above the horizontal axis and between the lowest and greatest values of the range.

C. Gamma Correction

Inspired by the RSWHE method it 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.

The AGC method can progressively increase the low intensity and avoid the significant decrement of the high intensity. The proposed AGCWD method automatically calculated the gamma parameter via probability density to combine the TGC and THE methods efficiently. Ultimately the AGCWD method generates the clearest luminance while avoiding the distortion of image features.

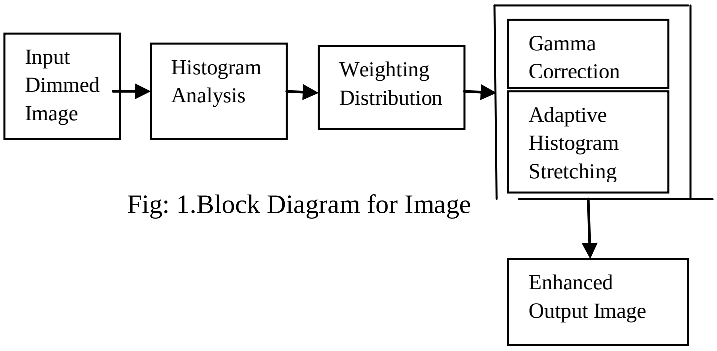

Fig: 1.Block Diagram for Image

Fig: 1.shows the flowchart of the proposed AGCCE method. For the dimmed image used as input, most of the pixels are densely distributed in the low-level region. Based on the weighting distribution function, the fluctuant phenomenon can be smoothed, thus reducing the over-enhancement of the gamma correction. The proposed AGCWD method can enhance a color image without generating artifacts or distorting the color. The image may still lack in contrast locally.

To measure the differences between the enhanced video generated by the TB method a feature similarity index was used for FR image-quality assessment. It is important to note that an FSIM value of 1 represents the highest quality, with 0 representing the lowest quality illustrates the FSIM of each frame generated by the AGCWD method with the TB simplification.

D. Adaptive histogram stretching

Finally Adaptive histogram stretching can be divide the image into several rectangular domains compute an equalizing histogram and modify levels so that they match across boundaries depending on the nature of the non-uniformity of the image. Adaptive histogram equalization uses the histogram equalization mapping function supported over a certain size of a local window to determine each enhanced density value. It acts as a local operation. Therefore regions occupying different gray scale ranges can be enhanced simultaneously.

Histogram stretching is a simple image enhancement technique that attempts to improve the contrast in an image by `stretching' the range of intensity values it contains to span a desired range of values. For examplethe full range of pixel values that the image type concerned allows. It differs from the more sophisticated histogram equalization in that it can only apply a linear scaling function to the image pixel values.

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. According to this method partition the given image into blocks of suitable size and equalize the histogram of each sub blocks .In order to eliminate artificial boundaries created by the process, the intensities are interpolated across the block regions using bicubic interpolating functions.

HVS is adapted to the structural information in images. The visual information in an image is often very redundant, while the HVS understands an image mainly based on its low level features, such as edges and zero crossings. In other words the salient low-level features convey crucial information for the HVS to interpret the scene. Accordingly perceptible image degradations will lead to perceptible changes in image low level features, and hence a good IQA metric could be devised by comparing the low level feature sets between the reference image and the distorted image. According to the enhancement results both the THE and DCRGC methods produced very serious luminance and color distortions in the output frames. The BBHE, DSIHE, RSIHE, and RSWHE methods reduced the distortions produced by the THE method, but the enhancement results are still unacceptable.

IV.EXPERIMENTAL RESULTS

A visual assessment was performed for grayscaleimagesaswell as for color images. Fig (a) shows the original man image featuring a man relaxing in a gazebo during a day with limited light, while other sub-pictures show enhanced images with equalized histograms generated by each method. Some adverse effects were generated by the THE, BBHE, DSIHE and RSIHE methods due to non-uniform equalizations. For example, the color of the sky region and the man’s skin was distorted after performing these methods, as shown in fig (b) and (e). Additionally the RSWHE method did not preserve a sufficient level of the brightness of the original image, thus producing a result with limited contrast, as shown in fig. (f). As demonstrated by fig (g), the DCRGC method was an improvement on the THE method, but some minor artifacts still exist in the sky region.

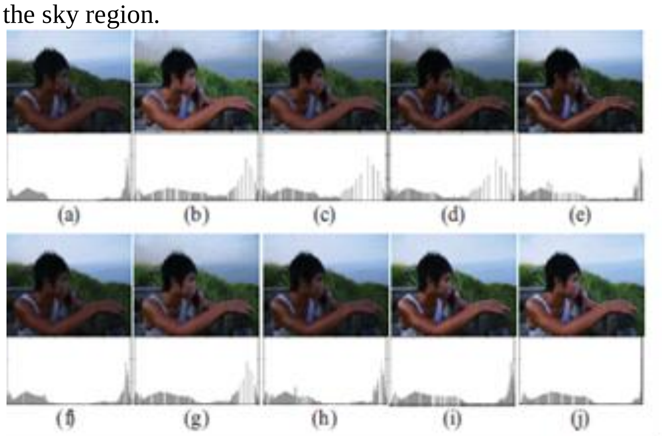

Fig:.2 A man image

The AGCWD method modified the brightness in the portion of the image containing skin, yet the contrast was still insufficient, as displayed in fig (h). The AGCCE method optimized the contrast, as shown in fig(i). unfortunately, the enhanced color appears unnatural when compared to that of the original image.In fig (j) shows the AGCCE method produced an acceptable image without unnatural or limited contrast. The histogram should be drawn for the given image is depicted below,

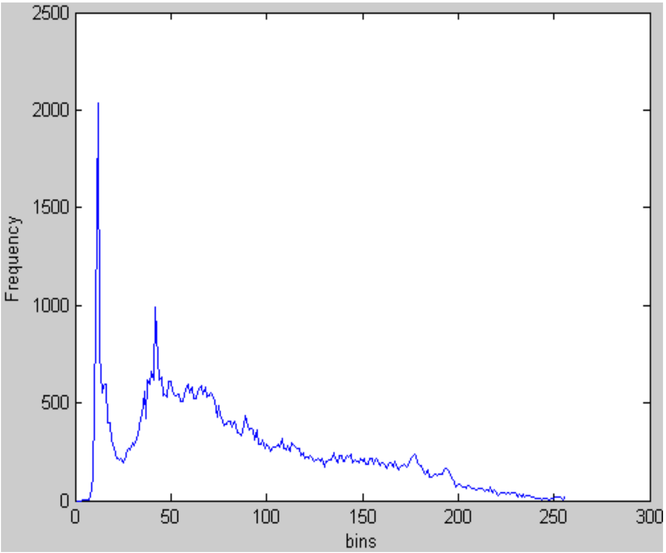

Fig:.3 Histogram Representation

V.CONCLUSION

An adaptive gamma correction and stretching method can be used for enhancing both images and video sequences. The proposed method is composed of three major steps. First, the histogram analysis provides the spatial information of a single image based on probability and statistical inference. In the second step, the weighting distribution is used to smooth the fluctuant phenomenon and thus avoid generation of unfavourableartifacts. In the third and final step, gamma correction and adaptive histogram stretching can automatically enhance the image contrast through use of a smoothing curve. According to the analysis of time consumption, the proposed method can be implemented in a real-time video system with limited resources.

REFERENCES

[1] Shith Chia Huang,FanChiehCheng,and Yi Sheng Chiu,"Efficient Contrast Enhancement Using Adaptive Gamma Correction with Weighting Distribution"IEEETrans.Image Process.;vol. 22,no.3,Mar 2013.

[2] T. Arici, S. Dikbas, and Y. Altunbasak, "A histogram modification framework and its application for image contrast enhancement," IEEETrans. Image Process, vol. 18, no. 9, pp. 1921–1935, Sep. 2009.

[3] H.-D. Cheng and H. J. Xu, "A novel fuzzy logic approach to contrast enhancement," Pattern Recognit., vol. 33, no. 5, pp. 809–819, May 2000.

[4] A. Polesel, G. Ramponi, and V. Mathews, "Image enhancement via adaptive unsharp masking," IEEE Trans. Image Process., vol. 9, no. 3,pp. 505–510, Mar. 2000.

[5] T. Celik and T. Tjahjadi, "Automatic image equalization and contrast enhancement using Gaussian mixture modeling," IEEE Trans. Image Process., vol. 21, no. 1, pp. 145–156, Jan. 2012.

[6] M. Hanmandlu and D. Jha, "An optimal fuzzy system for color image enhancement," IEEE Trans. Image Process., vol. 15, no. 10, pp. 2956–2966, Oct. 2006.

[7] M. Hanmandlu and D. Jha, "An optimal fuzzy system for colorimageenhancement," IEEE Trans. Image Process., vol. 15, no. 10, pp. 2956–2966, Oct. 2006.

[8] M. Hanmandlu, O. P. Verma, N. K. Kumar, and M. Kulkarni, "A novel optimal fuzzy system for color image enhancement using bacterial foraging," IEEE Trans. Instrum. Meas., vol. 58, no. 8, pp. 2867–2879, Aug. 2009.

[9] K. S. Sim, C. P. Tso, and Y. Tan, "Recursive sub-image histogram equalization applied to gray-scale images," Pattern Recognit.Lett.,vol. 28, no. 10, pp. 1209–1221, Jul. 2007.

[10] M. Kim and M. G. Chung, "Recursively separated and weightedhistogram equalization for brightness preservation and contrast enhancement,"IEEE Trans. Consum. Electron., vol. 54, no. 3, pp. 1389–1397,Aug. 2008.