Image Contrast Enhancement Using Nonlinear Stretching In Automatic Mode

D.SUSMITHA [1], D.SRILEKHA [2], MV.SUMA [3], S.VAISHNAVI [4], P.JULIAN [5]
[1]UG Scholar, Dept of ECE, Andhra Engineering College, Atmakur, AP, India.
[2]UG Scholar, Dept of ECE, Andhra Engineering College, Atmakur, AP, India.
[3]UG Scholar, Dept of ECE, Andhra Engineering College, Atmakur, AP, India.
[4]UG Scholar, Dept of ECE, Andhra Engineering College, Atmakur, AP, India.
[5]Associate Professor, Dept of ECE, Andhra Engineering College, Atmakur, AP, India.

ABSTRACT
Automatic picture augmentation is examined. Contrast enhancement by adaptive nonlinear stretching is proposed employing piecewise linear adjustment of the brightness scale to get an average brightness value close to the middle range of brightness. A study is being conducted to determine the efficiency of various nonlinear stretching algorithms for monochrome images using well-established no-reference metrics for integral image contrast.

1. INTRODUCTION

The great majority of current image processing, image processing, and image analysis applications [1] require some form of automatic image quality enhancement. The widespread use of contemporary digital image processing technology has made automatic image quality enhancement more significant than ever. Basic quantitative characteristics [2] determine the image's quality. [3] Contrast is the most important quantitative aspect of an image, which greatly influences its quality and visual perception. As a whole, increasing contrast is the best way to improve image quality [1, 3]. In this study, the issue of enhancing photographs' contrast automatically while keeping computational expenses to a minimum is addressed (Section II). Improved contrast enhancement for complex monochrome images is the goal of this research. An adaptive nonlinear stretching of the brightness scale utilising piecewise linear transformation of the brightness scale is presented in which the average value of the brightness of the converted image is closest to the middle range of brightness values.

2. LITERATURE SURVEY

The loss of important features is caused by oversaturating and enhancing certain areas of the image. To cut down on Human sight appears to be the most significant of the five senses. Images are the primary source of visual information and provide the majority of the information individuals get through their sense of sight. As a result, computer vision's primary objective is to extract usable information from images. In low-light situations, photographs generally lack aesthetic appeal since the majority of the image's information is obscured by the region's low visibility, causing a considerable drop in the image's quality. Low-quality images have a substantial impact on the performance of computer vision algorithms that demand high-quality inputs (medical imaging, tracing, navigation, etc.). As a result, before moving on to further processing, it is important to improve the low light photos. It is the primary objective of the low-light image enhancement method to produce visually appealing photos and to deliver more information than the original images that can be used in computer vision applications. Methods already in existence concentrate primarily on enhancing contrast, while others are concerned with maintaining naturalness. Because there is no standard definition of naturalness preservation, it's up to the individual to decide. Naturalness in practise is dependent on factors such as lighting variance, colour preservation, and attention to detail.

When rectifying lightness inconsistencies in low-light photographs, you may end up with strange outcomes. While collecting data in dark areas, low-light image enhancement algorithms should be able to maintain lighting in various locations. The most straightforward method for enhancing photographs taken in low light is to linearly increase the pixel intensity values. Information hidden in dark areas can be retrieved using this type of procedure Several strategies for improving brilliant saturation, on the other hand, have been presented. These picture enhancing techniques seek to maintain the brilliant image information while capturing information hidden in the darker parts.

Histogram equalisation (HE)-based methods, non-linear intensity transformation (NIT)-based methods, and Retinex theory-based methods are the three main categories of modern picture enhancing approaches. HE is an image enhancement technique that is both adaptable and simple to use. A histogram of the input image is used to calculate the cumulative distribution function (CDF) for adjusting the pixel intensity values in high-efficiency (HE). When using HE, you can reduce image saturation, however the resultant photographs will have artefacts. LHE, a local variation of the He, is used to perform the HE on an area of the screen that has been pre-defined. Although LHE enhances the HE's performance, it comes at a hefty cost in terms of computing complexity. Proposals for improved performance of the general He are numerous. Restrictions such as brightness preservation, contrast limiting, imposing a plateau limit, and histogram modification are all included in this category. Contrast enhancement is the primary goal of HE-based approaches, not illumination. A nonlinear transformation function is applied to the input image intensity levels in NIT based approaches to produce enhanced images.

To enhance images, non-linear monotonic functions like gamma are employed. These approaches work well even in low-light situations, and the photographs they produce are visually appealing. Although these methods require human modification of many parameters to regulate the augmentation, this increases the computational complexity of the algorithm. No consideration is given to the geographical correlations among the intensity levels. As a result, the improved outcomes look out of place in natural settings. Retinex's theory believes that the image is broken down into two elements, light and reflectance, in order to offer a realistic model. Retinex (SSR) and multiscale retinex (MSR) are examples of early approaches.

3. PROPOSED SYSTEM

Adaptive nonlinear stretching is proposed in this work as a method for automatically enhancing monochrome photographs. An image's brightness can be enhanced by adjusting its brightness scale so that the average brightness of the transformed image is close to the middle of the brightness range. An adaptive piecewise linear modification of the brightness scale is presented to process the initial image.:

$$y_i = \begin{cases} 0, & if\ x_i \le x_{\min} \\ \dfrac{k}{b - x_{\min}} \cdot (x_i - x_{\min}), & if\ x_{\min} < x_i \le b \\ k + \dfrac{1-k}{x_{\max} - b} \cdot (x_i - b), & if\ b < x_i < x_{\max} \\ 1, & if\ x_i \ge x_{\min} \end{cases} \quad (6)$$

where b - value of adaptation level, parameter; k – value of stretching factor, parameter, where

$$k \in [0, 1],\ \ b \in [0, 1]. \quad (7)$$

The value of the adaptation level b is determined by the brightness distribution of initial image.For the case of unimodal distribution, the adaptation level b is equal to the average value of the brightness:

$$b = mean(x) = \overline{x} = \int_0^1 x \cdot p(x) dx. \quad (8)$$

In the case of multimodal distribution, the value of the adaptation level b is proposed to be equal to the optimal threshold by Otsu's method for separate the image elements into two classes [6]:

$$b = x_{otsu}, \quad (9)$$

where xotsu - value of the optimal threshold by Otsu's method. The value of the stretching factor k for a preset value y of average brightness of the transformed image is defined as:

ISSN: 0972-2750
Vol-12 Issue-10 No.01: 2022

$$\bar{k} = b \cdot \frac{(1-b)\cdot \bar{y} - \int_b^1 xp(x)\,dx + b \cdot \int_b^1 p(x)\,dx}{\int_0^b xp(x)\,dx + b \cdot \int_b^1 p(x)\,dx - b \cdot \int_0^1 xp(x)\,dx} \quad (10)$$

where y – the predicted average value of the transformed image. For this case it is assumed that y = 1 2 .
The value of the parameter k is determined by the brightness distribution of the original image and, in the general case, does not satisfy condition (7). Excessively large and negative values of the parameter k lead to significant distortions of the initial image. To eliminate possible distortions of initial image due to its excessive stretching is assumed that the value of parameter k (6) is limited by the interval:

$$k \in [(1-\mu)\cdot b, \mu + (1-\mu)\cdot b] \quad (11)$$

where μ – parameter, that limits the range of possible values for k, 0 < μ < 1.The parameter k is taken equal to the value from the interval (11) which is closest to the value k :

$$k = \begin{cases} \mu + (1-\mu)\cdot b, & if \;\; \bar{k} > \mu + (1-\mu)\cdot b \\ \bar{k}, & if \;\; (1-\mu)\cdot b \le \bar{k} \le \mu + (1-\mu)\cdot b \\ (1-\mu)\cdot b, & if \;\; \bar{k} < (1-\mu)\cdot b \end{cases} \quad (12)$$

The proposed method of image enhancement is defined in accordance with (6), (8)-(10), (12).

4. RESULTS AND DISCUSSION

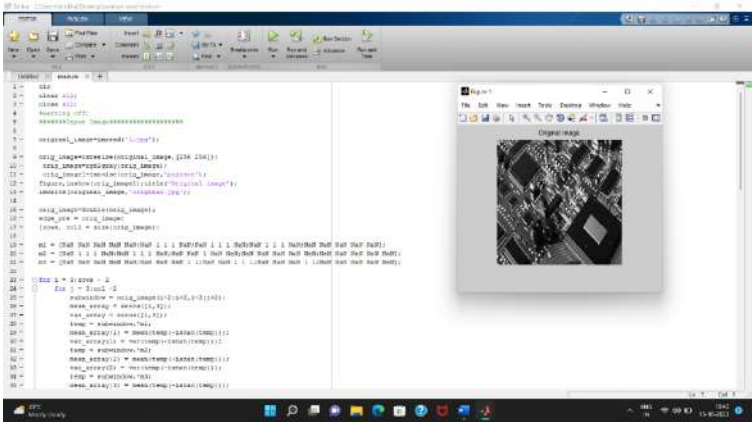

Figure 1

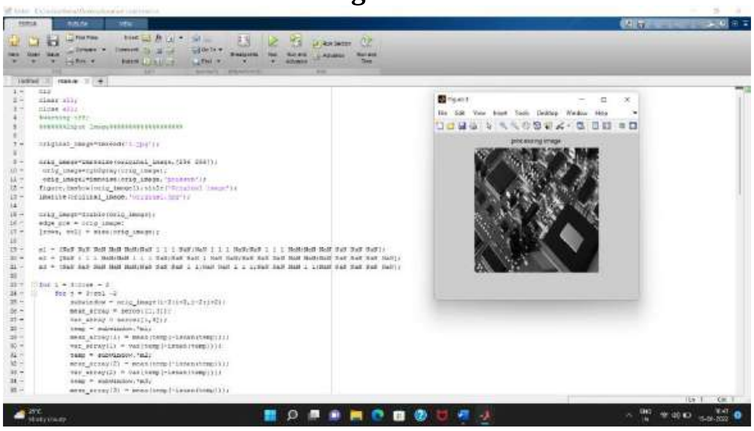

Figure 2

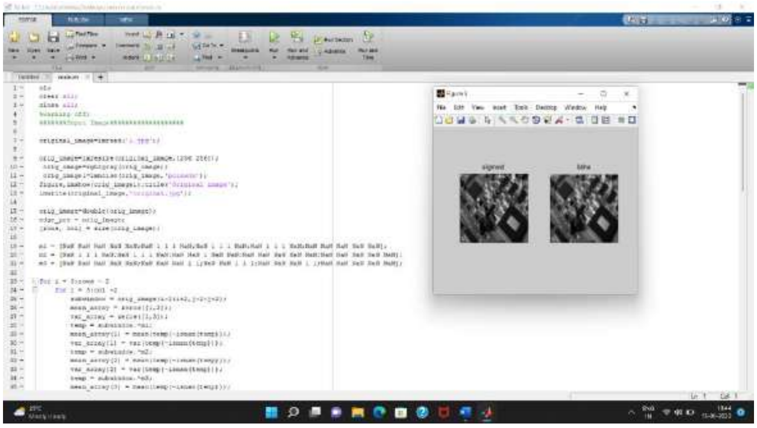

Figure 3

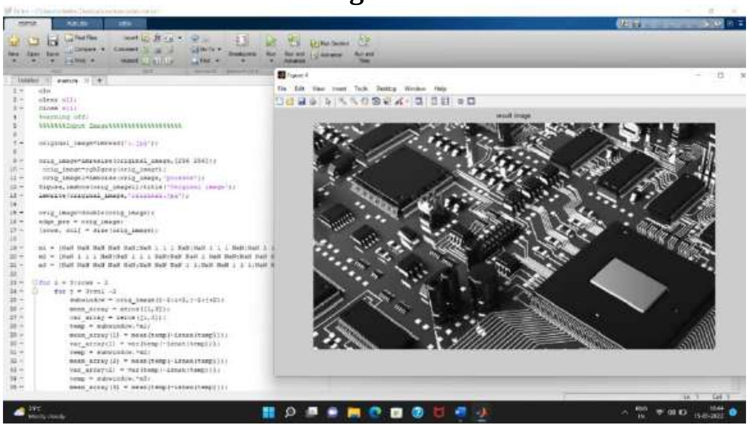

Figure 4

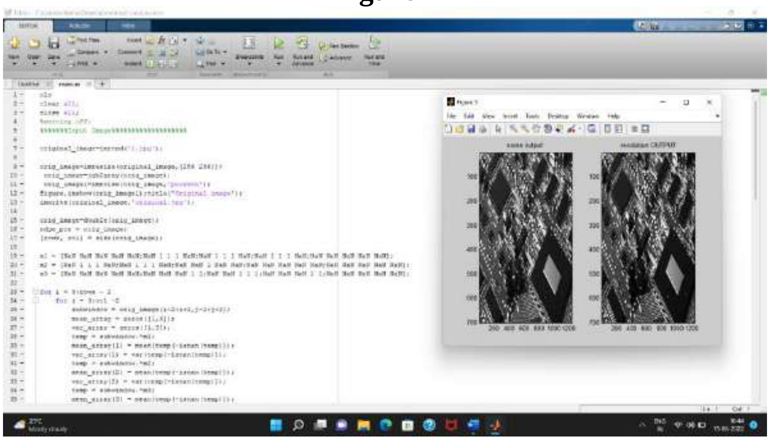

Figure 5

5. CONCLUSION

It was discussed in this research how to automatically enhance complex monochrome photographs while keeping processing expenses to a reasonable level. We looked at a number of well-established methods for improving images using nonlinear statistical non-inertial modifications of images. An adaptive nonlinear stretching method that uses piecewise linear transformation of the brightness scale has been developed, where the average brightness of the changed image is close to the middle of the brightness range. The proposed and well-known methods of picture contrast enhancement based on histograms were investigated in automatic mode using well-known contrast metrics with no reference. Nonlinear stretching by adaptive piece-wise linear transformation of the dynamic range delivers an efficient image improvement for all test images without lowering the contrast of small-sized objects... It is possible to recommend the proposed adaptive nonlinear stretching approach for picture enhancement in automatic mode since it provides effective augmentation of the contrast.

REFERENCES

[1] R. C. Gonzalez, R. E. Woods, Digital Image Processing, 2nd edn, Prentice Hall, New Jersey (2002).

[2] Z. Wang, A. C. Bovik, Modern Image Quality Assessment, in: Synthesis Lectures on Image, Video, and Multimedia Processing, Morgan and Claypool Publishers, New York (2006), Vol.2, No.1, pp.1-156.

[3] W. K. Pratt, Digital Image Processing: PIKS Inside. 3rd edn, John Wiley & Sons, New York (2001).

[4] S. Saruchi, "Adaptive Sigmoid Function to Enhance Low Contrast Images", International Journal of Computer Applications, 2012, Volume 55, No.4, pp. 45-49.

[5] Y. T. Kim, "Contrast Enhancement using Brightness Preserving BiHistogram equalization", IEEE Transactions on Consumer Electronics, Vol. 43, no. 1, pp. 1-8 (1997).

[6] N. Otsu, "A threshold selection method from gray-level histograms". IEEE Trans. Sys., Man., Cyber. 9: pp. 62-66 (1979).

[7] V. F. Nesteruk, V. A. Sokolova, "Questions of the theory of perception of subject images and a quantitative assessment of their contrast", Optikoelectronic industry. - 1980. – No. 5, pp. 11-13.

[8] E. Yelmanova, Y. Romanyshyn, "No-reference contrast assessment by image histogram", in Proceedings of 14th Int. Conf. CADSM 2017, pp. 148–152. IEEE, Lviv, Ukraine (2017).

[9] R.A. Vorobel, Loharyfmichna obrobka zobrazhen' [Logarithmic Image Processing], Naukova Dumka (2012), Kyiv, Ukraine

