SINGLE IMAGE CONTRAST ENHANCER BASED ON PROPOSED MEDIAN EQUALIZED STRETCHED RETINEX (MESR) METHOD

[1]Pooja Vaishnav, [2]Prof. Swapnil Nema

[1]M.Tech Scholar, [2]Professor
Global nature care sangathan group of institutions, Jabalpur

***Abstract*: The noise remains as large residual errors after motion compensation. The typical digital cameras can only capture images with a dynamic range of thousands in magnitude just because of that limited dynamic range of digital cameras, poor visibility causes due to overexposure in bright regions and underexposure in dark regions of a captured image. During processing of very dark images mostly specific algorithms being adopted for enhancement process which causes of low dynamic range images remains largely untouched.**

If the intensity of noise is higher than the signal then the conventional denoising techniques cannot work properly. For the said problem there are many approaches being developed for low-light image enhancement but still Low contrast and noise remains a barrier to visually pleasing videos in contrast conditions. To capturing videos in concerts, parties, social gatherings, and in security monitoring situations are still an unanswered problem. In such conditions the image enhancement of low quality image is a really tedious job. This paper is elaborating a survey of different type of methods and technologies that have been used and implemented in the area of image enhancement. The study is further going on to find a technique so that more accuracy can obtained in image enhancement.

***Keywords*: AF: Adaptive filter, SNR: Signal to Noise Ratio, MSE: Mean Square Error, HSI: Hue Saturation and Intensity**

I-INTRODUCTION

From last few years, there has been substantial work on image processing and wide improvements being carried out in image processing including resolutions and sensitivity. Despite these improvements, still there is a problem to capture a high dynamic range images and videos in low-light conditions especially when light is very low. Various image enhancement techniques are thus highly needed to recover image details or lift image aesthetics. For example, the rich user-generated contents from social media can be fully adopted to optimize the scene composition [2] [3].

Figure 1. Images of contrast conditions, such as nighttime (first row), backlight (second row)

In these learning based methods, novel pattern analysis models [4] [5] are necessary to capture the semantics from visually similar exemplars. Aiming at changing a photograph at the content level, the learning based methods are usually computationally expensive. Furthermore, for processing an arbitrarily new photograph, sufficient training exemplars are needed at the server side. We argue that there is no need to process every image in visual big data at the cloud server side. For example, to deal with challenging imaging conditions, the image manipulation has to be on the pixel-wise level, where efficient filtering at the side of each mobile device can be more feasible.the density of a CMOS image sensor is rapidly growing. However, if the size of each pixel in the high-density image sensor becomes smaller, low-sensitivity and noise amplification problems occur, especially in low-light images. To solve this problem, many image signal processors (ISPs) adopt digital image enhancement algorithms. Since a simple intensity amplification algorithm results in various undesired artifacts, sensor-based pixel binning [1–4] algorithms with noise reduction function in the image signal processor (ISP) [5–7] have been proposed in the literature. More specifically, a basic sensor-based pixel binning method groups multiple neighboring pixels into one to increase the sensitivity of the resulting pixel at the cost of reduced spatial resolution. In order to reduce the side effect of brightness amplification, various noise reduction algorithms were also proposed to separate noise from the original image before brightness amplification. However, a basic sensor-based pixel binning method cannot avoid loss of spatial resolution, and noise reduction is still an open problem in the imaging sensor technology. The proposed work extends the digital pixel binning algorithm in a context-adaptive manner to prevent undesired artifacts including noise amplification, intensity saturation, and loss of resolution.

Sensor-based pixel binning is designed to increase the sensitivity of an image sensor by combining multiple photodiodes into one bin at the cost of decreasing the spatial resolution as shown in Figure digital pixel binning can accumulate multiple pixel values without losing the spatial resolution ..

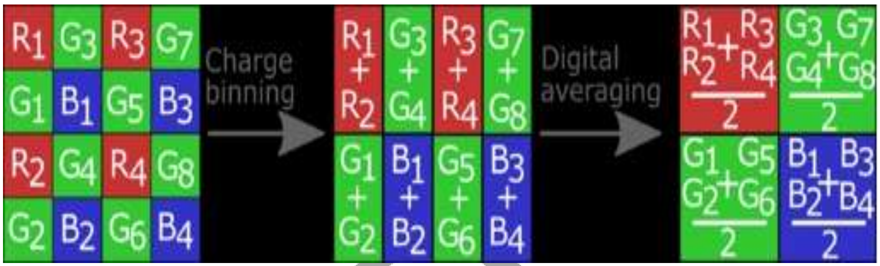

Figure 2 Digital image Binning

Since the sensor-based pixel binning method does not reuse combined pixels as shown in Figure 1.2, it decreases the spatial resolution inversely proportional to the bin size. On the other hand, the digital pixel binning method reuses pixels used for adjacent bins as shown in Figure 1.2. The result of digital pixel binning can be considered a low-pass filtered version of the input image whose intensities are multiplied by the bin size. For this reason, spatial resolution is preserved in the pixel binning process while the details are smoothed by low-pass filtering.

Contrast image Enhancement by Temporal Noise Reduction and Non-local means denoising: Local Mean filter take the mean value of group of pixels surrounding to target pixel to smooth the image where as "Non Local Means" filtering take a mean of all pixels in the image, weighted by how similar those pixels are to the target pixels. If the image sequences are temporally correlated, noise can be reduced effectively by temporal filtering [14] because of temporal (inter-frame) filter can exploit the correlation to achieve high noise attenuation [14]. In the working areas of the image frames it cannot be applied as it is because it creates a motion blur. In respect to identified the true noise the temporal filter may use. Most of the noise is removed by the temporal filtering and the remaining noise can be exaggerated by the Non-local means denoising. The level of noise is much higher in low-light environment, edges and textures are often over smoothed during the denoising process.

Adaptive Histogram equalization: Adaptive Histogram Equalization is image processing technique. Greater is the Adaptive Histogram stretch greater is the contrast of the input image [11]. Adaptive Histogram Equalization is one of the foremost familiar, computationally quick and straightforward to implement techniques for image enhancement but it mostly prefer for contrast enhancement of digital images [11]. A Adaptive Histogram is a graphical representation of the distribution of data while an image Adaptive Histogram is a graphical representation of the number of pixels in an image as operate of their intensity. The HE Adaptive Histogram equalization technique is used to stretch the Adaptive Histogram of the input image. If the distinction of the image is to be exaggerated then it means that the Adaptive Histogram equalization distribution of the corresponding image has to be widened. Adaptive Histogram equalization is that the most generally used enhancement technique in digital image process because it deliver better result and cleanness in output that other [11]. The Adaptive Histogram of an input image is generally refers to a Adaptive Histogram of the pixel intensity values. The bar graph may be a graph showing the amount of pixels in a picture at every totally different intensity worth found therein image. For an 8 bit grayscale image there are 256 different possible intensities are available and so that the Adaptive Histogram will graphically display 256 numbers showing the distribution of pixels amongst those grayscale values. Adaptive Histograms take input as color picture and may provide individual demonstration of red, green and blue color channels of Adaptive Histograms [10]. It tries to change the special bar graph of a picture to closely match the same distribution. The main aspire of this process is to obtained a uniform distributed Adaptive Histogram by using the cumulative density function of the given image. HE consist of following advantages such as, It suffers from the problem of being poorly suited for retaining local detail due to its global treatment of the image. Small-scale details that are often associated with the small bins of the Adaptive Histogram are eliminated [10].

Tone Mapping: Tone Mapping is a technique used in image processing and computer graphics to map one set of colors to another to approximate the appearance of high dynamic range image in a medium that has a more limited dynamic ranges. Tone mapping is the process of amplify intensity of low-light image by judicious Adaptive Histogram adjustment [13]. Mostly three types of Adaptive Histograms of RGB color are computed separately after grouping pixels of each color channel from a CFA (color filter array) image, and then they are transformed with adaptively selected low and high feature thresholds [13]. System use transform value which should be less than 1 to map dark pixels to a bright level. Because most of pixels have very small intensity values ranging about 5% of maximum intensity in extremely contrast condition, stretching all pixels causes an associate degree incorrect conversion with a high offset intensity. By clipping pixels below the highest value of Adaptive Histogram and pixels with intensity beyond top 99th percentile, system can obtain satisfactory tone-mapped result while color balance is retaining always better than the result generated [12]. The principle behind the tone mapping process is to extend the dynamic range of dark image areas and meanwhile it slightly affected in other areas. If system wish to deliver an output in high dynamic range (HDR) image on paper or on a display, there must somehow convert the wide intensity range in the image to the lower range supported by the display [12]. The tone mapping technique is operated on brightness level (luminance) [12].

Adaptive Intensity Transfer Function: The intensity-transfer function realized in the proposed algorithm is a tunable nonlinear transfer function for providing dynamic-range alternate arrangement adaptively. To attain this level a hyperbolic tangent function satisfies the condition of continuous differentiability. Another improvement of the hyperbolic tangent function is that the output value always comes in the range from zero to one for any positive input. It guarantees that output always follow the desired range of value. The adaptive hyperbolic tangent function characterized by the local statistical characteristics of the image where as proposed intensity-transfer function is local tone mapping operator. The purpose of this task is to improve the low intensity pixels while preserving the stronger pixels [9].

Contrast enhancement: image enhancement techniques involve processing an image or image frame to make it superior in terms of visibility. The superior quality is achieved by modifying contrast or dynamic range or both in an image or image frames [5]. The main objective of contrast enhancement process is to adjust the local contrast in different regions of the image or image frames, so that the details in dark or bright regions are brought out and disclosed to the human viewers. Contract enhancement is mostly applied to given image frames or images to archive a superior visual representation of the image by transforming original pixel values using a transform function [5]. The contrast enhancement is performed using a technique almost like to auto-leveling the contrast of low-light images [5].

Spatial Domain Techniques: Spatial domain techniques directly operate on image pixels where noise reduction is applied to each frame individually. Exploitation of given pixel values are done to attain the desired improvements. Spatial domain techniques such as the Logarithmic Transforms, Adaptive Histogram Equalization and Power Law Transforms, are all based on the direct manipulation of the pixels values available in image. This technique is applicable in the area of directly altering the gray level values of individual pixels and the overall contrast of the entire image [8]. Point Operation: Point operations are applied to individual pixels only.

Mask Operation: In mask operation, each pixel is modified according to neighborhood pixel values. Global Operation: All pixel values are taking into consideration for performing operation [7].

Frequency Domain Techniques: Frequency domain techniques are based on the manipulation of the orthogonal transform of the image rather than the picture itself. A frequency domain technique is based on the frequency content of the image [6]. The concept used by frequency domain technique for image enhancement is to compute a 2 dimensional structure of an image. For instance the 2-D DFT, manipulating the transform coefficients by an operator and then performing the inverse transform. The Magnitude and Phase are the two components of an orthogonal transform of the image. The frequency content is available in magnitude where as the phase is used to reset up the image back to the spatial domain [6]. The standard orthogonal transforms are discrete cosine transform, discrete Fourier transform and Hartley Transform. The frequency content of the image enables to transform domain operations, therefore high frequency content such as edges and other suitable information can easily modified [6].

Context based fusion Enhancement: The intention behind the use of context-based image enhancement is to extract and fuse the meaningful information of image sequence captured from a fixed camera under different light conditions [6]. Context-based fusion means to insert high quality information from the same scene such as to overcome bright regions and blurred details to improve the low quality image. The information which is being gathered and analyzed from multiple images (scenes) is used for image up gradation purpose [4]. Using context based fusion the information is automatically combined in images at different time intervals by image fusion. All the data and information from original low quality sources (scenes) is combining with high quality background scenes in same viewpoint [4]. There are so many methodologies were invented for image up gradation but low contrast and noise are major barrier to visually pleasing images in contrast conditions. Such conditions make it more complex and challenging. Hence it has been realized that there is a wide scope to make an investigation in contrast image enhancement specially to determine the intensity of individual pixel channel values and enhanced them as per the requirement.

II-LITRATURE REVIEW

Hyo-Gi Lee et al [3] In this paper, they propose a novel contrast enhancement algorithm for contrast level images, which preserves image details and color constancy based on Intensity retinex. they decompose an input low contrast image into luminance and chrominance components in Lab color space, which reflects the perception characteristics of human visual system well, and enhance the luminance component only. they first estimate illumination using adaptive bilateral filtering, which guarantees the available range of reflectance by considering proper neighboring pixels according to their luminance and color values. Then they enhance the contrast of the estimated illumination image using parabolabased tone mapping function. Finally, the enhanced luminance and the original chrominance are combined together to yield an enhanced color image. Experiment results show that the proposed algorithm enhances image details and edge structures by alleviating halo artifacts, and also preserves naturalness faithfully by avoiding color shifting artifacts. In this work [3], they proposed a Intensity retinex-based image contrast enhancement algorithm to preserve color constancy. they first decomposed an input image into luminance and chrominance components using Lab color space. Then they estimated the illumination by applying bilateral filtering adaptively according to the color similarity and luminance distribution among neighboring pixels. Moreover, they improved the contrast of luminance image by performing parabola-based tone mapping to the estimated illumination image. Finally, they generated an enhanced color image by combining the enhanced luminance and the original chrominance together. Experiment results demonstrated that the proposed algorithm enhances the contrast of input low contrast images, while preserving image details and natural colors faithfully. However, when an input image has a very contrast level, the proposed algorithm often yields an over-enhanced result. they will address this problem as a future work.

Fan Wu et al [2] To improve the quality of low-light image, they proposed a new HSI based enhancement algorithm. This new algorithm enhances the luminance of low-light level images while preserving image contrast and details. First, the original RGB image is converted into HSI color space, then the intensity and saturation components are processed with different enhancement methods, but the hue component remains unchanged, the segmentation exponential enhancement algorithm is applied to saturation component S, then apply the Adaptive Histogram equalization to intensity component I and then the intensity component I is divided into high and low frequency sub-bands with wavelet transform, the Intensity retinex algorithm is applied to the low frequency sub-band to adjust image luminance while the improved fuzzy enhancement is applied to the high frequency sub-band to enhance image details. Finally, reconstruct the component I with inverse wavelet transform, and the reconstructed component I will be synthesized with H and the enhanced S components to get a clear RGB image. By taking advantage of HSI color space and the improved enhancement algorithm, the enhancement of low illumination color image has been achieved. According to the experiment results, this algorithm can obviously improve the visual effect of contrast color image.

In this paper [2], an enhancement algorithm for low-light images is proposed. First, the image is transformed from RGB space to HSI space, and some effective algorithms are applied for the Intensity component and Saturation component in HIS color space for enhancement purpose. The segmented exponential transformation algorithm is used to let the image saturation become more suitable for the visualization of the human eye, and then apply the Adaptive Histogram equalization algorithm to the component I to enhance the image contrast. After using the Adaptive Histogram equalization algorithm, the enhanced image is processed by wavelet transform to get the low frequency sub-band and high frequency sub-band. Intensity retinex algorithm is applied to the low frequency component to enhance the brightness of the image. The fuzzy enhancement algorithm is applied to the high-frequency components to make the edge of the image become more clear. The experimental results prove the validity of the proposed algorithm from both subjective and objective aspects after comparing with some existing algorithms.

Xiaojie Guo et al [1] captures images in low-light conditions, the images often suffer from low visibility. Besides degrading the visual aesthetics of images, this poor quality may also significantly degenerate the performance of many computer vision and multimedia algorithms that are primarily designed for high quality inputs. In this paper, they propose a simple yet effective low-light image enhancement (LIME) method. More concretely, the illumination of each pixel is first estimated individually by finding the maximum value in R, G and B channels. Further, they refine the initial illumination map by imposing a structure prior on it, as the final illumination map. Having the well constructed illumination map, the enhancement can be achieved accordingly. Experiments on a number of challenging low-light images are present to reveal the efficacy of their LIME and show its superiority over several state-of-the-arts in terms of enhancement quality and efficiency.

In this paper[1], they have proposed an efficient and effective method to enhance low-light images. The key to the low-light enhancement is how well the illumination map is estimated. The structure-aware smoothing model has been developed to improve the illumination consistency. they have designed two algorithms: one can obtain the exact optimal solution to the target problem, while the other alternatively solves the approximate problem with significant saving of time. Moreover, their model is general to different (structure) weighting strategies. The experimental results have revealed the advance of their method compared with several state-of-the-art alternatives. It is positive that their low-light image enhancement technique can feed many vision-based applications, such as edge detection, feature matching, object recognition and tracking, with high visibility inputs, and thus improve their performance.

Author/ Journal/Year	**Method**	**Outcome**
Xiaojie Guo / IEEE transactions/2016	smoothing model has been developed for Low-light Image Enhancement via Illumination Map Estimation (LIME)	lightness order error (LOE) obtain is 2.394
Fan Wu, / IEEE Proceeding/2017	HSI Colour Space developed along with Ratinex and Fuzzy enhancement for Low-Light Image Enhancement	(STD) observe is 76.7, (Grad) is 29.05 and Entropy (Ent) is 7.63.
Hyo-Gi Lee/ APSIPA ASC 2015	Colour Preserving Contrast Enhancement for Contrast Level Images based on Intensity retinex	MSE observe is 0.35 and PSNR observe is 38.8703
Takuya Mikami/ ICIP 2014	capturing color and near-infrared images with different exposure times for image enhancement under extremely low-light scene	MSE observe is 0.29 and PSNR observe is 36.24

Table.1 Literature Review

PROBLEM STATEMENT: Due to insufficient lighting conditions, low illumination color images are often appears and not only brings an uncomfortable visual feeling to human, but also is not beneficial for image analysis and comprehension and so on, they need to be enhanced to improve visual effect of such images.

The enhance algorithm based on fixed Histogram was used by [3] and [5] which works well for certain images only, and also the gray level of the processed image by [3] and [5] is reduced, so that some details are partially lost. Due to its multi-resolution characteristics, the enhancement algorithm based on wavelet transform [1], [2] and [4] both can describe the outline of the image, but also can highlight the details of the image, but there is no great effect on changing the contrast of the image, and the multilevel wavelet decomposition will increase the computational complexity and reduce the efficiency of the algorithm. Proposed work is using Adaptive Histogram equalization, which improves the contrast of the any image, with significant light enhancement process like Interpolation and Retinex.

III-CONCLUSION

This paper presents a survey of different types of methods and technologies that have been used for image enhancement. But the low contrast and noise remains a barrier to visually pleasing images in contrast conditions. In that condition, to find out a more accuracy in image enhancement process there is need to detect and measure the intensity level of individual pixel channel as well as have to present an appropriate enhancement factor for enhancement purpose, so that effective and efficient image enhancement process will be created. A low-light image enhancement algorithm is presented in the paper. By decomposing a low-light image into the Red, green and blue component and performing Adaptive Histogram equalization in all R,G and B components color stretching is been performed. Further illumination component extracted, it offers a solution to expand illumination and enhances image details separately. Specifically, the illumination component is processed using DWT, intensity retinex and interpolation methods. This solution enhances low-light images and effectively avoids distortions (for example color) and annoying artefacts (e.g., blurring, halo). Then, the final result is obtained by concatenation of illumination component with hue and saturation. Experimental results demonstrate that the enhanced images by the proposed method are visually pleasing by subjective test and the performance of the proposed method outperforms the existing methods in terms of both , , MSE, LOE, SNR and entropy. Moreover, the proposed algorithm is efficient because the computation complexity is less then [1]. The proposed method has great potential to implement in real-time low-light image processing.

REFERENCES

[1] Xiaojie Guo, Member, IEEE, Yu Li, Member, IEEE, and Haibin Ling, Member, IEEE LIME: Low-light Image Enhancement via Illumination Map Estimation, IEEE TRANSACTIONS ON IMAGE PROCESSING, National Natural Science Foundation of China under grant 61402467, the US National Science Foundation Under grants CNS-1618398 and IIS- 1350521, 2016

[2] Fan Wu, KinTak U, Low-Light Image Enhancement Algorithm Based on HSI Color Space, 2017 10th International Congress on Image and Signal Processing, BioMedical Engineering and Informatics (CISP-BMEI 2017), 978-1-5386-1937-7/17/$31.00 ©2017 IEEE

[3] Hyo-Gi Lee, Seungjoon Yang, and Jae-Young Sim, Color Preserving Contrast Enhancement for Contrast Level Images based on Intensity retinex , Proceedings of APSIPA Annual Summit and Conference 2015, 16-19 December 2015, 978-988-14768-0-7©2015 APSIPA

[4] D. J. Jobson, Z. Rahman, and G. A. Woodell. A multiscale intensity retinex for bridging the gap between color images and the human observation of scenes. IEEE Trans. Image Process, vol. 6(7):pp. 965–976, Jul. 1997.

[5] R. Kimmel, M. Elad, D. Shaked, R. Keshet, and I. Sobel. A variational framework for intensity retinex. Int. J. on Computer Vision, vol. 52(1):pp. 7–23, Apr. 2003.

[6] Takuya mikami, daisuke sugimura and takayuki hamamoto, capturing color and near-infrared imageswith different exposuretimes for image enhancement under extremely low-light scene, 978-1-4799-5751-4/14/2014 ieee

[7]Zhenqiang Ying, Ge Li, Yurui Ren, Ronggang Wang, and Wenmin Wang, A New Low-Light Image Enhancement Algorithmusing Camera Response Model National Science Foundationof China (No.U1611461), Shenzhen Peacock Plan (20130408183003656),and Science and Technology Planning Project of Guangdong Province,China (No. 2014B090910001 and No. 2014B010117007).

[8] Utsav Kumar Malviya, Vivek Singh Rathore, Champalal Lalani, EIGHT ADJACENT REGRESSION BASED IMAGE INTERPOLATION FOR HR IMAGES, International Journal for Research Trends and Innovation, 2019 IJRTI | Volume 4, Issue 3 | ISSN: 2456-3315

[9] D. H. Choi, I. H. Jang, M. H. Kim, and N. C. Kim. Color image enhancement using single-scale intensity retinex based on an improved image formation model. In Signal Process Conf, pages 1–5, Aug. 2008.

[10] C.-T. Shen and W. Hwang. Color image enhancement using intensity retinex with robust envelope. In proc. IEEE Int. Conf. Image Process, pages 3141–3144, Nov. 2009.

[11] Utsav Kumar Malviya, Champalal Lalani, Gopal Kumar , NEW METHOD FOR TIMING OFFSET ESTIMATION IN OFDM FOR PREVENTING ORTHOGONALITY, International Journal for Research Trends and Innovation, 2019 IJRTI | Volume 4, Issue 3 | ISSN: 2456-3315

[12] S. Chen and A. Beghdadi. Natural rendering of color image based on intensity retinex. In proc. IEEE Int. Conf. Image Process, pages 1813–1816, Nov. 2009.

[13] B. Li, S. Wang, and Y. Geng. Image enhancement based on intensity retinex and lightness decomposition. In proc. IEEE Int. Conf. Image Process, pages 3417–3420, Sep. 2011.

[14] S. Wang, J. Zheng, H. M. Hu, and B. Li. Naturalness preserved enhancement algorithm for non-uniform