IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

IMPLEMENTATION OF THE CONTRAST ENHANCEMENT AND WEIGHTED GUIDED IMAGE FILTERING ALGORITHM FOR EDGE PRESERVATION FOR BETTER PERCEPTION

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ABSTRACT

Digital image processing has revolutionized the content perception from physical photo appearance to digital image appearance by implementing the digitalization. Digital image processing helps to achieve good process in various research fields but still enhancing the degraded content to normal content is concerned area. Image enhancement attains attention due to its high application applicability. A novel framework is proposed in this paper by combine the edge based weighting scheme with guided image filtering to get proposed weighted guide image filtering (WGIF). WGIF scheme yields low complexity as GIF and preserve the sharp gradient information. WGIF has ability to provide the local and global smoothing filters advantages and successful to avoid the halo artifacts. In practical WGIF is for single image feature enhancement. Experimental results provide low complexity and high performance over traditional state of art methods.

Keywords: Guided Image Filter, Halo Artifacts, Low Complexity, Image Enhancement

I INTRODUCTION

Digital image is defined as “An image is not an image without any object in it”. Human visual system has ability to perceive the objects in digital image using edges in efficient manner. Halo artifacts introduces blur in digital image which makes perception of content difficult. Various filtering techniques have designed in literature to preserve the global and local statistics but none can meet the desired requirements and various algorithms yields high complexity which fails them to achieve practical reliability.

Digital image processing domain has different research fields and all these research fields have applications ranging from low level to high level. Edge preservation in all these research fields attains attention and implementation of smoothing filters has ability to filter noise content by preserving the edge information. Smoothing algorithms can be classified into two types namely global filters such as bilateral filter , tri-lateral filters , and finally guided image filter . Global filters attain images with good quality but these filters are highly expensive. Local filters are

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

considered as alternative to global filters which are simple and cost effective but fail to conserve the sharp edges information like global filters.

When local filters are forcefully adopts to smooth edges it results halo artifacts. Halo artifacts produced by bi-lateral filter and guided image filter are fixed in equipped way using similarity parameter in terms of range and spatial. Bi-lateral filtering mechanism is considered as adaptive filter and this adaptive mechanism helps to handle the halo artifacts and on negative side it destroys the 3D convolutional form . An interesting algorithm named weighted guided image filtering scheme is proposed in this paper by combining the edge-based weighting scheme along with guided image filtering. Calculation of edge based weighting scheme is calculated by using 3×3 local variance in a guidance image. This local variance scheme of one individual pixel is normalized by all pixels local variance in guidance image. The acquired normalized weights of all pixels are then adaptively adapted to WGIF. WGIF helps to avoid halo artifacts in accurate manner for excellent visual quality. The intricacy of WGIF is same as GIF. The proposed weighted guide image filtering (WGIF) is applied for multiple purposes as single image mist removal, single image detail enhancement and different exposed images fusion.

II RELATED WORK

Pierre Charbonnier, Laure Blanc-Feraud, Gilles Aubert, and Michel Barlaud [1] proposed an algorithm, called ARTUR, to avoid problems that are ill posed and must be regularized. Usually, a roughness penalty is imposed on the solution. The difficulty is to avoid the smoothing of edges, which are very important attributes of the image. In this paper, they first give conditions for the design of such an edge-preserving regularization in which under the few conditions it is possible to introduce an auxiliary variable whose role is twofold. First, it marks the discontinuities and ensures their preservation from smoothing. Second, it makes the criterion half-quadratic. The optimization is then easier, as well as a deterministic strategy, based on alternate minimizations on the image and the auxiliary variable, and can be applied in a large number of applications in image processing.

Z. Farbman, R. Fattal, D. Lischinski, and R. Szeliski [2] paved the new way to construct edge-preserving multi-scale image decomposition in order to control the spatial scale of the extracted details, and it is often desirable to manipulate details at multiple scales, while avoiding visual artifacts. It current base detail decomposition techniques, based on the bilateral filter, are limited in their ability to extract detail at arbitrary scales. Thus they advocate the use of an alternative edge-preserving smoothing operator, based on the weighted least squares optimization framework, which is particularly well suited for progressive coarsening of images and for multi-scale detail extraction and effectiveness of edge-preserving decompositions in the context of LDR and HDR tone mapping, detail enhancement, and other applications.

J. Chen, S. Paris, and F. Durand [3] presented a new data structure—the bilateral grid, that enables fast edge-aware image processing. By working in the bilateral grid, algorithms such as bilateral filtering, edge-aware painting, and local histogram equalization become simple manipulations that are both local and independent.It parallelize algorithms on modern GPUs to achieve real-time frame rates on high-definition video Also demonstrated the

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

method on a variety of applications such as image editing, transfer of photographic look, and contrast enhancement of medical images.

K. He, J. Sun, and X. Tang [4] represented a novel explicit image filter called guided filter which is derived from a local linear model, the guided filter computes the filtering output by considering the content of a guidance image, which can be the input image itself or another different image. The guided filter can be used as an edge-preserving smoothing operator like the popular bilateral filter, but it has better behaviors near edges. The guided filter is also a more generic concept beyond smoothing: It can transfer the structures of the guidance image to the filtering output, enabling new filtering applications like dehazing and guided feathering. Moreover, the guided filter naturally has a fast and no approximate linear time algorithm, regardless of the kernel size and the intensity range. Currently, it is one of the fastest edge-preserving filters. Experimental result shows that the guided filter is both effective and efficient in a great variety of computer vision and computer graphics applications, including edge-aware smoothing, detail enhancement, HDR compression, image matting/feathering, dehazing, joint upsampling, etc.

III METHODLOGY

Digital image composed of three contents namely color, shape and texture. Assessing the image information based on edges (gradient) has ability to perform the enhancement tasks and fusion in reliable way in the field of digital image processing. Acquiring the digital content of images with good visual quality in computational photography and other applications with complexity is still concerned area because many global filters yields high complexity which show adverse impact on enhancement process.. In this paper, a strategy is implemented to enhance the image contents based on edge information by incorporating the guided image filter (GIF) with novel edge based weighting scheme to form weighted guided image filter with minimal complexity and better visual quality.

The edge information plays an important role in implementing weighted guide image filtering algorithm for various applications. The key element of proposed algorithm is to ensure a confined linear model between a guidance image (G) and filtering output ($\hat{J}$). The confined linear model ensures filtering output ($\hat{J}$) has an edge only if the respective guidance image (G) has an edge. Consider G as guidance image and the respective variance is denoted by$\sigma^{2(P')}$. The edge based weighting scheme $\gamma G(P')$ is well defined by local variance of 3×3 local variance windows of all pixels as follows

$$\gamma G(P') = \left(\frac{1}{N}\right) \sum_{p=1}^{N} \frac{[\![\sigma]\!]^2 G(P')+\varepsilon}{\sigma^2 G(P)+\varepsilon} \quad (1)$$

Where

ε denotes a small constant selected for input image dynamic range "L" and its value is $(0.001 \times L)$^2. All guidance image pixels are used in the computation of $\gamma G(P')$. The pixel P' importance is measured by weighting mechanism with respect to whole guidance image. The value of weighting mechanism is larger than 1 if P' is at an edge and value is small if P' is in a flat area. The feasible blocking artifacts appearance can be efficiently prevented in the final image and the smoothing operation is carried out at weighting mechanism. The proposed weighted

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ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

filtering scheme is incorporated with cost function and finally the minimization of differences between image to be filtered and filtered output as follows

$$E = \sum_{p \varepsilon \Omega_\varsigma} \left[\left[(ap' G(p) + bp' -]X(p))^2 + \frac{\lambda}{\gamma G(p')} ap'^2 \right] \right]$$
(2)

The computation of ap' and bp' are as follows

$$ap' = \frac{\mu G \odot X, \varsigma 1(P') - \mu G, \varsigma 1(P') \mu X, \varsigma 1(P')}{\sigma^2 G, \varsigma 1(P') + \left(\frac{\lambda}{\Upsilon G(P')} \right)} \quad (3)$$

$$bp' = \mu X, \varsigma 1(P') - ap' \mu G, \varsigma 1(P') \quad (4)$$

Where $\odot$ is represented as two matrices element by element product and along with matrices mean values are also taken into consideration in order to yield final value as

$$\ddot{J}(p) = apG(P) + bp \quad (5)$$

To make the analysis easy both X and G are assumed to be same for perfection and when we consider a pixel with a edge has value larger than 1 and in WGIF it is close to 1 is better than GIF value. The above analysis show better edge information is obtained by WGIF than GIF

IV RESULTS

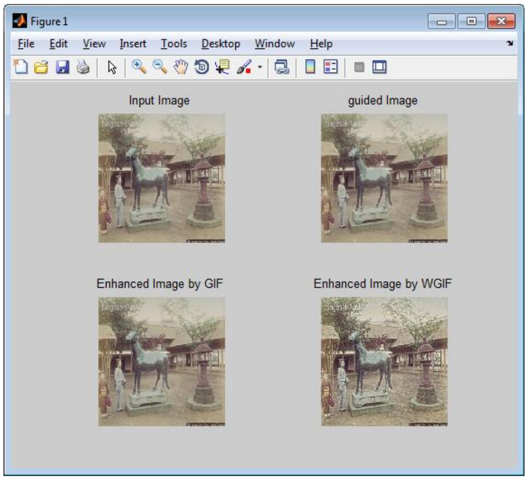

Figure 1: (a) Input image (b) Guided image (c) Enhanced image by GIF (d) Enhanced image by WGIF

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ISSN (O) 2319 - 8354
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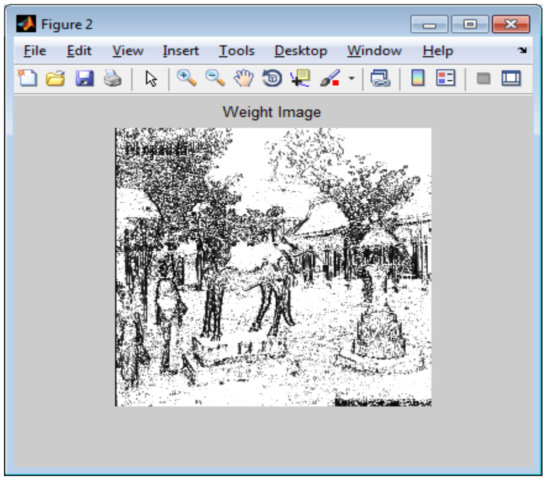

Figure 2: Weighted image

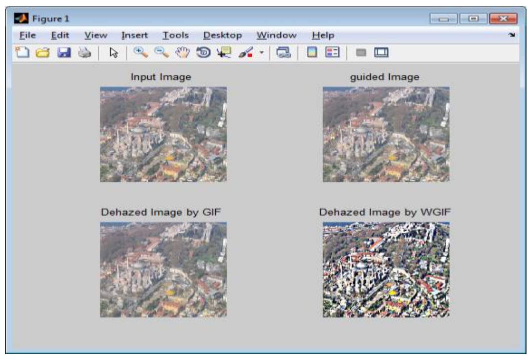

Figure 3: (a) Input image (b) Guided image (c) Dehazed image by GIF (d) Dehazed image by WGIF

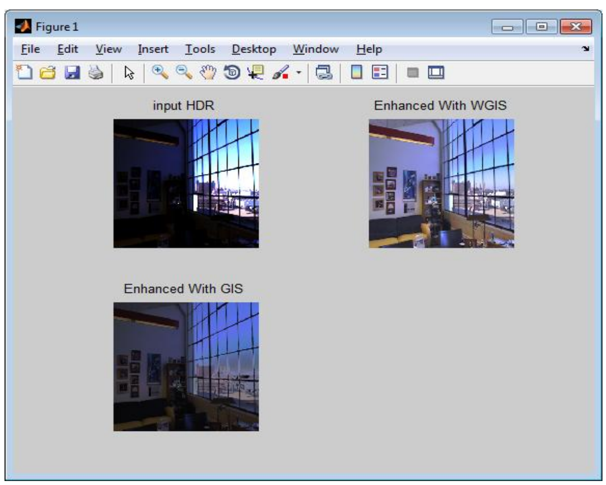

Figure 4: (a) Input HDR (b) Enhanced with WGIS (c) Enhanced with GIS

V CONCLUSION

An optimized framework is proposed in this work by incorporating the edge based weighting scheme with guided image filtering to get proposed weighted guide image filtering (WGIF). WGIF scheme yields low complexity as

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

GIF and preserve the sharp gradient information. WGIF has ability to provide the local and global smoothing filters advantages and successful to avoid the halo artifacts. In practical WGIF is for single image feature enhancement.

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