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Improve Content Adaptive Detail Enhancement Algorithm Using Dark Channel Prior Technique and JTF

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Abstract-- Detail enhancement is needed to enhance the images in digital image processing. The existing technique boosts the effect of noises and the quality of enhance image is not better. The proposed algorithm is different from all these existing papers in the sense that our method provides the first order fidelity for pixels at edges while other methods provided the zero order fidelity for the pixels at edges.The proposed algorithm also remove the artifacts like halos artifacts and gradient reversal artifacts.

Index Terms- Detail Enhanced Image, Dark Channel Prior, Fidelity, Haze Image, JTF.

I. INTRODUCTION

Image detail enhancement is needed to improve visual appearance of images. The algorithm is derived by solving a newly formulated L_0 norm based global optimization problem. Unlike the optimization problem, the optimization argument in our formulated problem is the detail-enhanced image rather than the base layer. An edge aware weighting is also incorporated into the regularization term in the obtained algorithm. This enables the edges to be preserved better by the proposed algorithm. The proposed algorithm is different from all these existing papers in the sense that our method provides the first order fidelity for pixels at edges while other methods provided the zero order fidelity for the pixels at edges.

A. Applications of Image Enhancement

1. **Industrial inspection/quality control:** Quality control is a procedure by which operations analysis the superiority of every factors concerned in construction.
2. **Surveillance and security:** Surveillance is the observing of the performance, actions, or further varying data, generally of public for the reason of affecting, managing, directing, or defending them like CCTV cameras.
3. **Face recognition:** It is a computer appliance for mechanically specifying or Justifying an individual from a digital photographer a video frame from a video source.
4. **Gesture recognition:** It is an area in computer science and language technology with the objective of explaining person gestures via mathematical operations. Gestures can begin from any physically motion of body or state but usually invent from the face or hand.
5. **Medical image analysis:** It is the method, procedure and ability of making visual depictions of the internal of a body for clinical examination and medical interference.
6. **Autonomous vehicles**: It involves the use of artificial intelligence system to support a vehicle's operator.
7. **Virtual reality:** It is referred to as immersive multimedia, is a computer-simulated atmosphere that can replicate bodily existence in places in the real world. Virtual reality can reconstruct sensory experiences, including virtual flavour, aroma, etc.

II. RELATED WORK

[1] proposed two level set evolution for manmade object extraction from high spatial resolution remote sensing images. Entity extraction from distant sensing images is most important research topic in the field of surveying and mapping. In most past methods a little attention has been paid for improving the computational efficiency. In recent years, LSE has been shown to be very promising for object extraction in the field of image processing because it can hold topological changes automatically while attaining high accuracy. **[2]** has presented that by histogram equalization, contrast enhancement of an image can be effectively worked. On the other hand, this technique is to produce irrelevant visual deterioration likes saturation effect. To overcome this drawback is by preserving the mean brightness of input image inside the output image, two stages of algorithm are to be applied.**[3]** proposed image contrast enhancement approach that equalizes the components of color using co-occurrence histogram. And then the enhanced color components are the transaction between co-occurrence histogram equalization and dark channel prior. Histogram equalization (HE) and its derivatives are the most common used methods. **[4]** proposed a simple but effective image prior-dark channel prior to remove haze from a single image. The dark channel prior is a kind of statistics of outside fog-free images. It is based on a key observation-most local patches in outside fog-free images contain some pixels where intensity is very less . **[5]** has

proposed a pixel-based dark/bright channel prior and fog density estimate method for dehazing process. Firstly estimation of atmospheric light is done to observe the effect of light. Then transmission map is used for estimation. Here two methods are used. A pixel-based dark/bright channel prior is used first. After that fog density estimation method is used to estimate fog for removal process. Then bilateral filter is used for refining the transmission map. **[6]** presented an image haze removal of wiener filtering based on dark channel prior. The algorithm is mainly to estimate the median function in the use of the media filtering method based on the dark channel, to make the function more accurate and then combine the result with the wiener filtering . **[7]** discussed that the dark channel prior is a straightforward yet efficient way to approximate the scene depth information using one sole foggy image. However the prior fails for pixels with low colour dispersion. **[8]** described a novel and efficient single image enhancement algorithm for haze image. As they monitor that, the contrast and intensity of haze image after using dark channel prior approach will necessarily tend to be lower than those of the real scene, they used histogram requirement to make an enhancement on image after dark channel prior approach. **[9]** proposed novel widespread guided image filtering method with the suggestion image generated by signal sub-space projection technique. It accepts complicated parallel study through Monte Carlo imitation to choose the dimensions of signal subspace in the patch-based noisy images.

III. PROBLEM FORMULATION

A. Problem In Existing Work

In existing work, the content adaptive detail enhancement algorithm cannot remove the artifacts like halos artifacts and gradient reversal artifacts. This technique also boost noise which affects the visual appearance of images.The concept of fog is also not introduced in existing technique and fog also affects the sharpness of images.

B. Problem Definition

The proposed algorithm use joint trilateral filter to remove noise and dark channel prior technique is used to remove the affect of fog on given set of images.

IV. PROPOSED ALGORITHM

After analyzing, there are various gaps in existing literature survey. To overcome this problem, the following methodology has been proposed.

The steps that are used in algorithm to enhance the image are as follows:-

Step 1: Select I_m as input image.

Step 2: Define Parameters.

λ =0.16; //Largrange factor.
K =4; // Detail Amplify time.
E = L_0 Enhancing(I_m ,k, λ/$k_A{}^2$);

Step 3: Apply L_0 Enhancing.

3.1. Evaluate:

$$I_X = \{^{\circ}(\mathrm{S}(1), \mathrm{S}(\mathrm{m}) - \mathrm{S}(\mathrm{end}))\};$$
$$I_Y = \{^{\circ}(\mathrm{S}(1), \mathrm{S}(\mathrm{m}) - \mathrm{S}(\mathrm{end}))\};$$

3.2. The detail layer is enhanced k times the final image.k_p is then computed.

$$k_p 1 + \frac{k}{1 + e^{n\,(v_p - v_p)}} \ldots\ldots\ldots\ldots (1)$$

3.3. Computing (h,v) when E is known. The (h,v) estimation subproblem corresponds to minimizing.

$$\min_{h,v}\{\lambda . c(h,v) + \sum_p\{\beta((\partial_x(E_p\text{-}I_{P^A})\text{-}h_p)^2 + (\partial_y(E_p\text{-}I_{P^A})\text{-}v_p)^2))\}\}\ldots\ldots\ldots(2)$$

Step 4: Apply Dark Channel Prior.

$$j^{dark}) = \min_{c\varepsilon\{r,g,b\}}(\min_{y\varepsilon\Omega(x)}(j^c\,(\mathrm{y}))), \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where j^c is a colour channel of j and $\Omega(x)$ is a local patch centered at x.

The single dark channel is described as:

$$j^{dark\,(c)}(\mathrm{x}) = \min_{y\varepsilon\Omega(x)}\left(I^c(Y)\right), \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

And the dark channel of I can be written as:

$$I^{dark}(\mathrm{x}) = \min_{c\varepsilon\{r,g,b\}}\left(I^{dark\,(c)}(x)\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

$$j^{uwdark}(\mathrm{x}) = \min_{c\varepsilon\{g,b\}}(\min_{y\varepsilon\Omega(x)}(j^c\,(y))) \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

In order to recover the true radiance J of an underwater scene, we need to estimate B,t_α(x) and $t_\beta{}^c$ to calculate j^c(x).

$$j^c(\mathrm{x}).= \frac{I^c(x) - B^c \cdot t_\alpha(\mathrm{x})}{t_\beta{}^c(x)} \ldots\ldots\ldots (7)$$

Step 5: Apply joint trilateral filter.

Joint trilateral filter (JTF) is used to remove the artifacts like the gradient reversal artifacts. The process of JTF is firstly done under the supervision of the image G which can be another suggested image or the input image I itself. Let Ip and Gp be the intensity value at pixel p of the nominal channel image and guided input image, wk be the kernel window centered at pixel k, to be consistent with bilateral filter. JTF is then formulated by

$$JTF(I)_p = \frac{1}{\sum_{q \in w_k} W_{JTF}(G)} \sum_{q \in w_k} W_{JTF\ pq}(G) I_q \quad \text{.....(8)}$$

Input: filtering input image.
Output: filtering output q.

1: $\mu_I = \sum_{i=1}^{n} \sum_{j=1}^{m} (\frac{I_{I,J}}{N*M})$
$\mu_P = \sum_{i=1}^{n} \sum_{j=1}^{m} (\frac{I_{I,J}}{N*M})$
$corr_I = f_\mu$(I.*I)
$corr_{I_P} = f_\mu$ (I.*p)
2: $var_I = corr_I - \mu_I .* \mu_I$
$cov_{I_p} = corr_{I_p} - \mu_I .* \mu_I$
3: a=$\frac{cov_{I_p}}{var_I + \varepsilon}$
b =μ_P -a* μ_I
4: $\mu_a = f_\mu$(a)
$\mu_b = f_\mu$(b)
5: q = $\mu_a .* I + \mu_b$

V. EXPERIMENTAL RESULTS

Figure 1 shows the input image which will be used for proposed work on which technique content adaptive detail enhancement , dark channel prior and joint trilateral filter is applied.

Figure 1. Input image

Figure 2 shows the enhanced image that is obtained by applying existing technique i,e content adaptive detail enhancement algorithm.

Figure 2:Enhanced image

Figure 3 shows the output image that is obtained after applying dark channel prior technique and joint trilateral filter

Figure 3: Output image

VI. PERFORMANCE EVALUATION

Table 1 and figure 4 is showing the quantized analysis of the mean squared error. As mean square error need to be decreased so that the better results can get. The proposed method is showing better results than available methods.

TABLE I: MSE VALUES

Images	Base-Paper	Proposed
Image 1	0.0581	0.0453
Image 2	0.0758	0.0675
Image 3	0.1020	0.0647

Image 4	0.0599	0.0471
Image 5	0.0593	0.0538
Image 6	0.0421	0.0401
Image 7	0.1330	0.1241
Image 8	0.0336	0.0306
Image 9	0.0608	0.0380
Image 10	0.1180	0.1149

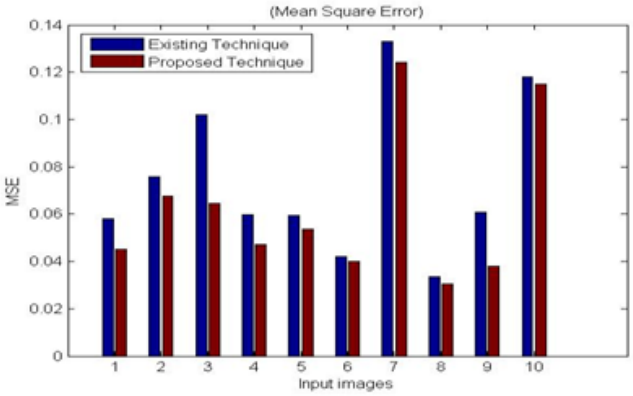

Figure 4: MSE Analysis

Table 2 and figure 5 is showing the quantized analysis of the enhancement metrics score. A smaller value indicates a higher quality. The enhancement metrics scores prove our proposed algorithm generally gives better results than the others**.** So the score increases and decreases as k increases.

TABLE II: ENHANCEMENT METRICS SCORE

Images	**Input**	**Existing**	**Proposed**
Image 1	4.3399	4.2142	3.9016
Image 2	6.8764	4.2237	4.2142
Image 3	6.4138	4.5341	4.2345
Image 4	6.0655	4.9992	4.6142
Image 5	7.1534	7.0715	5.2945
Image 6	6.3971	5.1946	4.0137
Image 7	7.8321	5.6513	4.0973
Image 8	7.1455	5.5762	4.4521
Image 9	5.8282	4.2310	4.2045
Image 10	4.4903	4.4303	4.2142

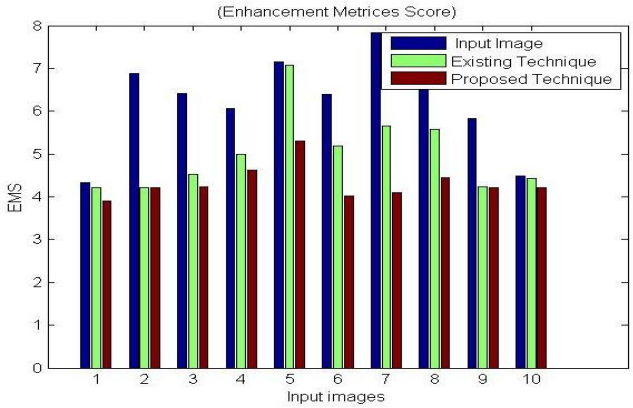

Figure 5. EMS ANALYSIS

VII. CONCLUSION&FUTURE SCOPE

The comparative analysis has clearly shown that the proposed technique is better than the available techniques. The quality of image is better than the existing technique.The effect of noise and fog is also covered in this paper and try to remove these effects. In near future, the technique is improved by using intelligence technique and also used appropriate filters to reduce the effect of noise.

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