An Improved Content Adaptive Detail Enhancement Algorithm

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Abstract-- Detail enhancement is required in digital image processing. The existing technique is very time consuming as it doesn't enhance the images directly and divides images into layers and it also introduced the effect of noise and fog in the resulting image This paper shows that content adaptive image detail enhancement technique provides better results as compared to existing methods. The proposed method also overcome the problems like noises and effect of fogs .

Key Words : Digital Image, Dark Channel Prior, Noise, Foggy Image.

I. INTRODUCTION

Image enhancement is very important in digital image processing. Image detail enhancement algorithms can increase visual appearance of images. They enhance fine details while avoid halo artifacts and gradient reversal artifacts around edges. The detail enhancement technique is a widely used image editing tool. Existing detail enhancement algorithms are based on edge preserving decomposition algorithms. Image edge-preserving decomposition algorithm consist of various filters for enhancing the image. Median filter, a well known de-noise filter, can be used as an edge preserving decomposition filter. In ,an iterative median filter was used as an edge preserving decomposition tool in a generalized unsharp masking algorithm. Bilateral filter combines a range filter with a domain filter to preserve edges. It is a simply and widely used local weighted average filter, but it may exhibit gradient reversal artifacts near some edges when used for detail enhancement. A guided image filter derived from a local linear model can avoid the gradient reversal artifacts, thus it out-performs the BF. The computational cost of all the local filters is low.

II. Content Adaptive Detail Enhance Optimization

Content adaptive image detail enhancement algorithm is used to enhance the image. By this technique, the various artifacts like halos and gradient reversal are removed from the given set of images. The image can be enhanced by increasing the value of pixels in the given image except at edges.

$$\min_{E}\{\sum_{p}(E_p - I_p)^2 + \lambda.C(E - KoI\}$$

Where E is the enhanced image, I is the input image, p is the pixel indicator of the image.

III. Related Work

[1] projected a fast yet tough technique to enhance the visibility of video frames using the dark channel prior united with fuzzy logic-based technique. The dark channel prior is a arithmetical uniformity of outdoor haze-free images based on the

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examination that most local patches in the haze-free images have pixels which are dark in at least one color channel. The combination of the dark channel and the fuzzy logic-based technique will make high quality haze-free images in real-time. **[**2] proposed perceptual models that can be able to forecast the value of distorted images with as little prior information of the images or their deformation as possible. The new IQA model, which is known as Natural Image Quality Evaluator is based on the production of a "quality aware" collection of statistical features based on a simple and successful space area natural scene statistic model. [3] proposed a novel unambiguous image filter is known as guided filter. Resultant from a local linear model and the guided filter evaluates the output of filtering by using the content of a guidance image, which can be the input image itself or a 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. Moreover, the guided filter obviously has a fast and non-estimated linear time algorithm, despite of the kernel size and the intensity range. Experiments explain that the guided filter is both successful and proficient in a great variety of computer vision and computer vision and computer graphics applications including edge-aware smoothing and dehazing. [4] presented a novel contrast enhancement process for backlit images that consists of three steps: i) calculation of the transmission coefficients via the dark channel prior, ii) generation of numerous images having different exposures based on the transmission coefficients, and iii) image fusion. Compared to global intensity transformation methods and spatially invariant contrast enhancement algorithms approach first extracts under-exposed regions using the dark channel prior map, and then performs spatially adaptive contrast particularly for backlit scenes and those with very broad lively range, while still preserving image details and color. [5] presented a depth evaluation process based on dark channel prior to build a depth map from a single 2D image of an outdoor scene for 3D display applications. The method computes a depth map using a sequence of image processing strategies such as dark channel calculation, edge detection, the edge-based iterative thresholding technique, the area split-and-merge algorithm, the forefront and background categorization, and the depth estimation with combination of dark channel and elevation information. Experimental results and comparisons show that the proposed system provides good depth evaluation in borders and regions of sky and buildings. [6] has recommended a model based on the physical process of imaging in foggy weather. In this model a fast haze removal algorithm that is based on a fast bilateral filtering with dark color prior is defined. The atmospheric scattering model is used to explain the formation of haze image. [7] has proposed a method by setting minimum channel prior for haze removal. It is based on a key fact that fog-free intensity in a color image is usually a least value of trichromatic channels. In dark channel prior to evaluate the transmission model it acts as a minimum filter for least concentration. This filter may occur halo artifacts, mainly in the nearby of edge pixels. In this algorithm instead of minimum filter they use accurate O(1) bilateral filter based on the function of raised cosines function to measure value of neighbour to get haze-free image. [8] proposed edge preserving smoothing technique to divide an image into two layers-first is smoothing layer and second one is detail layer. It is an useful image editing tool. The edges are preserved in the smoothing layer and detail layer. This method use a content adaptive L_0 smoothing method. The algorithm provides a superior weight to the area with detail information, which is most likely a flat area. The resulting smoothed image can preserve more edges and smooth the smoothing areas be formed. [9] presented a new system

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for meaningful structure extraction from texture. First, proposed novel variation measures to capture the nature of structure and texture. Secondly, fashioned a new optimization scheme to transform the original non-linear problem to a set of sub-problems that are much easier to solve quickly.

IV. PROBLEM FORMULATION

A. Problem In Existing Work

This dissertation showed that content adaptive image detail enhancement technique is better than the available methods. But it is found that the effect of noise and fog in digital images has been ignored in the existing literatures, As known in prior, noise and fog reduce the sharpness of images as well as it also disturb the potential edges in the given image.

B. Problem Definition

The proposed algorithm is justified as joint trilateral filter has ability to reduce the noise while preserving edges and also the use of dark channel prior will reduce the effect of fog from given set of images.

V.PROPOSED ALGORITHM

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

The steps performed to enhance the image are as follows:-

Step 0: In step 1 Input image is passed to the system and some pre-processing operations are applied on it.

Step 1: Apply content adaptive image detail enhancement.

Step 2: Evaluate the dark channel prior from the given set of images.

Step 3: Apply the restoration model to recover its radiance.

Step 4: Apply joint trilateral filter to reduce the noise with preserving edges.

Step 5: Get the final image.

Step 6: Evaluate parameters like PSNR,BER,RSME,MSR.

VI.EXPERIMENTAL SETUP

In order to implement the proposed algorithm, design and implementation has been done in MATLAB using the image processing toolbox. Result shows that the proposed method gives better results than the existing algorithms. Table1 is showing the various images that are used in the proposed work.

TABLE I: Various images that are used in proposed work

Image name	Extension	Size in K.Bs
Image 1	.jpg	23.0 KB
Image 2	.jpg	24.4 KB
Image 3	.jpg	32.9 KB
Image 4	.jpg	26.2 KB
Image 5	.jpg	24.3 KB
Image 6	.jpg	10.7 KB
Image 7	.jpg	14.2 KB
Image 8	.jpg	24.2 KB
Image 9	.jpg	3.63 KB
Image 10	.jpg	3.96 KB

VII.RESULTS

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

Figure 1. Input image

Figure 2 shows the enhanced image that is obtained by content adaptive detail enhancement algorithm.

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Figure 2:Enhanced image

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

Figure 3:Output image

VIII. PERFORMANCE EVALUATION

Table 2 and figure 4 shows the results of root mean square. Root mean square error is a frequently measured of the differences between values predicted by a estimator and the values actually observed As RMSE is to be minimized.

TABLE II:RMSE VALUES

Images	Existing Technique	Proposed Technique
Image 1	0.3193	0.2544
Image 2	0.2753	0.2598
Image 3	0.2492	0.2314
Image 4	0.2052	0.2003
Image 5	0.2411	0.2129
Image 6	0.2436	0.2319
Image 7	0.3062	0.2705
Image 8	0.1834	0.1749
Image 9	0.3986	0.3764
Image 10	0.2465	0.1949

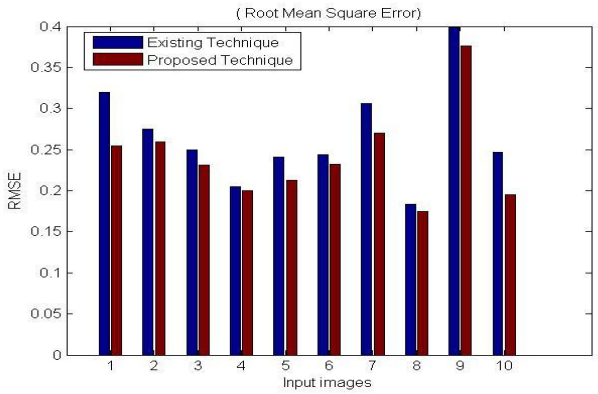

Figure 4:RMSE Analysis

Table 3 and figure 5 is showing the relative analysis of the Peak Signal To Noise Ratio (PSNR). As PSNR need to be maximized, so the main aim is to augment the PSNR as much as possible.

TABLE III: Result of Peak Signal To Noise Ratio

Images	Existing Technique	Proposed Technique
Image 1	60.4874	61.5692
Image 2	59.3353	59.8366
Image 3	56.8930	57.1914
Image 4	60.3564	61.3974
Image 5	61.8857	62.0952
Image 6	62.8611	63.2765
Image 7	60.3968	60.8266
Image 8	56.0695	56.1272
Image 9	56.1205	56.6167
Image 10	60.2941	62.3339

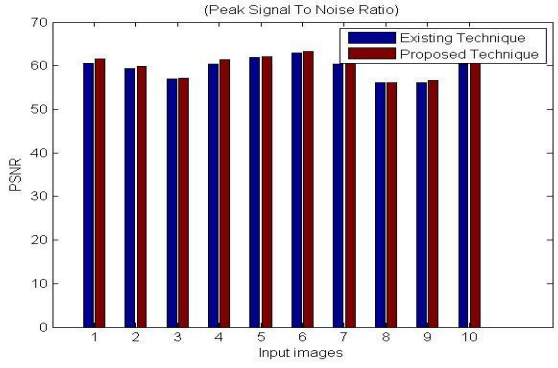

Figure 5. PSNR ANALYSIS

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Table 4 and figure 6 is showing the relative results of the BIT ERROR RATE (BER). As BER need to be minimized, so the main aim is to decrease the BER as much as possible.

TABLE IV: Result of Bit Error Rate

Images	Existing Technique	Proposed Technique
Image 1	0.0165	0.0162
Image 2	0.0169	0.0167
Image 3	0.0172	0.0167
Image 4	0.0166	0.0164
Image 5	0.0166	0.0163
Image 6	0.0162	0.0161
Image 7	0.0159	0.0158
Image 8	0.0166	0.0160
Image 9	0.0175	0.0174
Image 10	0.0177	0.0173

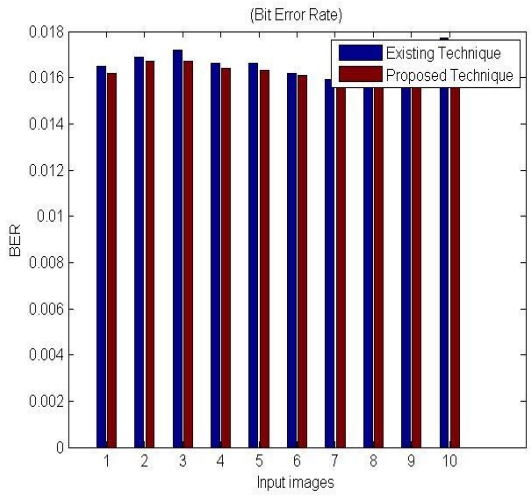

Figure 6:BER Analysis

IX.CONCLUSION&FUTURE SCOPE

In this paper, a survey on content adaptive detail enhancement technique has been done. The proposed algorithm is justified as joint trilateral filter has ability to reduce the noise while preserving edges and also the use of dark channel prior to remove fog from given set of images. The proposed technique is designed and implemented in the MATLAB tool along with the help of Image processing toolbox. In near future, improvements will be be done in proposed technique using swarm intelligence technique and using appropriate filters.

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