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A study on Image Dehazing by using Depth Estimation and Fusion with Guided Filter

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Abstract: *Haze is an atmospheric singularity that meaningfully degrades the visibility of outdoor sections. This is mostly due to the atmosphere particles that absorb and scatter the light. This thesis presents a novel single image methodology that improves the visibility of such ruined images. Our universal dehazing method that determining the atmospheric light and produces a spread map in the* YC_bC_r *color channels. The atmospheric light is estimated from the densest pixel. Here we use the edge information to represent the neighboring pixel's comparative depth information. With this relative depth information, we can build the equivalent atmospheric light to detain the edge halation. We create the spread map by appraising the atmospheric light except a continuous region which has no edge information. The method performs a per-pixel manipulation, which is straightforward to implement and then apply the Guided filter to improve the image quality. The experimental results demonstrate that the method yields results comparative to and even better than the more complex state-of-the-art techniques, having the advantage of being appropriate for real-time applications.*

Keywords: Fog, Haze, Air light, Transmission Map, Dark Channel, Fusion with Guided filter.

Introduction

The haze is an annoying factor when it appears in image, since it causes poor visibility. This is the major problem of some applications in the field of computer vision, such as surveillance, object recognition, etc. To obtain the clear images, haze removal is inevitable. Fog, mist and some other particles that degrade the scene image are the results of atmospheric absorption and light scattering. The radiance reached to camera along the sightline is reduced due to atmospheric light and it is changed by previously scattered light, which is named the air light. This degradation will cause the image to lose contrast and color correctness. Furthermore, the air light which affect the image depends on the depth of the scene. This knowledge is commonly used for dehazing problems.

Image Compression

It is concerned with minimizing the no. of bits required to represent an image. There are various applications of compression like broadcast TV, remote sensing via satellite, military communication, radar, teleconferencing, facsimile transmission, for educational & business documents, medical images that arise in computer tomography (CT), magnetic resonance imaging (MRI) and digital radiology, motion, pictures, satellite images, geological surveys, climate maps and so on.
Text compression – CCITT GROUP3 & GROUP4
Still image compression – JPEG

Video image compression -MPEG
Feature extraction: Feature extraction involves make simpler the amount of resources essential to describe a huge set of data accurately, e.g. Edge detection, corner detection, blob detection, ridge detection etc.
Pattern recognition: Pattern recognition is basically categorized as per the type of learning process used to generate the output value.
Multi-scale signal analysis: Some methods which are used in digital image processing include:
Pixilation: It is affected by displaying a bitmap or a section of a bitmap at such a huge size that distinct pixels are small single-color square display elements that comprise the bitmap are visible. Such an image is said to be pixelated.
Linear filtering: Filtering is a method for modifying or enhancing an image. For example, you can filter an image by increasing certain features or remove some other features. Filtering operation in which the value of given pixel in the output image is determined through applying certain algorithms on the input pixels. A pixel's neighbourhood is certain set of pixels, well-defined by their locations relative to that pixel.
Principal component analysis: Generalized principal component analysis for image representation and segmentation Anisotropic diffusion: In image processing anisotropic diffusion is also called Perona Malik diffusion process, is a method pointing at reducing image noise without eliminating important parts of the image content, like edges, lines or other details that are important for the interpretation and representation of the image.
Self-organizing maps: To transaction with the vast volume of information provided by remote sensing satellites, which create the images used for agriculture monitoring, urban planning, and deforestation finding and so on, several algorithms for image classification have been proposed in the literature. This article relates two approaches called Expectation maximization (EM) and self-Organizing Maps (SOM) useful to unproven image classification, i.e. data clustering without direct intervention of specialist guidance. The remote sensing images are accustomed test both algorithms and results are exposed relating to visual quality, matching rate and processing time.
Neural networks: Artificial Neural Networks are recent development tools that are modelled from biological neural networks. The powerful side of this new tool is its capability to solve difficulties that are very hard to be solved by traditional computing methods (e.g. by algorithms).

II. Research Methodology

Human eyes are very sensitive to brightness than color that why we use the atmospheric light estimation and produce a transmission map in the color channels. The atmospheric light is estimated from the pixel which are not transparent. The current algorithm takes up the top 0.1% brightest pixels in the dark channel prior. An image does not contain thedata on the edge of the sky or a wall in the region, the mis-projected value of the atmospheric light outcomes in failure of the defogging (dehazing) algorithm. Therefore, we use the edge data to characterize the neighboring pixel’s relative depth information. With this relative depth information, we can build the equivalent atmospheric light to restrain the edge halation. We produce the transmission map by guessing the atmospheric light excluding a continuous region which has no edge information and the transmission map as shown on below.

$$\tilde{t}(x) = 1 - \min_{c}\left(\min_{y=\Omega(x)}\left(\frac{I^{c}(y)}{A}\right)\right); \ J(x) = \frac{I(x) - A}{\max(\tilde{t}(x), t_0)} + A$$

where 0 *t*limits the transmission *t* (*x*) to a lower bound 0 *t* , that means a small amount of fog are preserved in very dense fog regions. In the experiment, we used 0 *t* _ 0.1. Color misrepresentation problem may occur in the compensation process to solve this problem the image restored by color correction via statistical RGB channel feature extraction of image. Then we can compute the RGB channel ratio between foggy and defogged images for color adjustment with image. The RGB channel ratio is represented as,

$R_{Ratio}\ mean(R_r) / mean(O_r)$

$G_{Ratio}\ mean(G_g) / mean(O_g)$

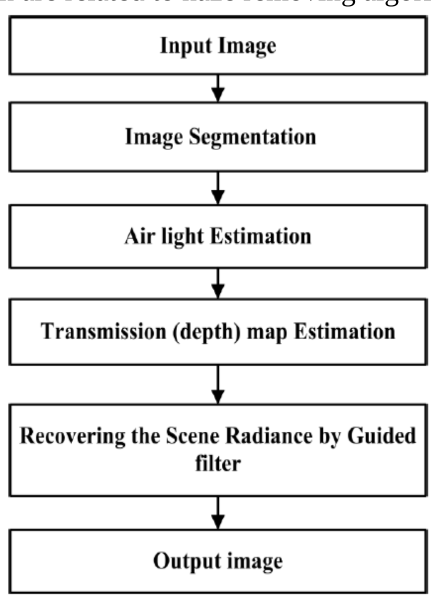
$B_{Ratio}\ mean(B_b) / mean(O_b)$

where R represents the defogged image an O the foggy image. Thus, we can acquire the color-corrected image using color equivalent of RGB channels of restored image, such as

$$J = \begin{pmatrix} R_{r1} & R_{g1} & R_{b1} \\ R_{r2} & R_{g2} & R_{b2} \\ & \cdots & \\ R_{rk} & R_{gk} & R_{bk} \end{pmatrix} \times \begin{pmatrix} R_{Ratio} & 0 & 0 \\ 0 & G_{Ratio} & 0 \\ 0 & 0 & B_{Ratio} \end{pmatrix}$$

where J represents the image color-corrected, and k the number of pixels.

Image dehazing process: We have taken the input image then we performed all possible operation on it. Flow diagram showing all the process which are related to haze removing algorithm.



III. Simulation Result

The algorithm proposed here will remove haze from an image surface short of earlier knowledge of the haze location upon that surface.

The projected technique is centered on determining the illumination profile of the image surface then we use this profile to remove the haze from the images. It is implemented using MATLAB 7.9.0 (R2009b) on i-5 processor with 4-GB RAM.

Figure 1: (a) Original Image, (b) Dehazed Image by using Multi scale Fusion (c) Dehazed Image by using Depth estimation Dehazing (d) Dehazed Image After Guided filter.

Table 1:

METHOD	VARIANCE	MEAN	SNR	MSE	PSNR	UIQI
Multiscale fusion	1.049	1.445	6.994	0.009	97.204	0.856
Depth Estimation with Guided Filter	1.049	1.335	8.813	0.005	99.129	0.970

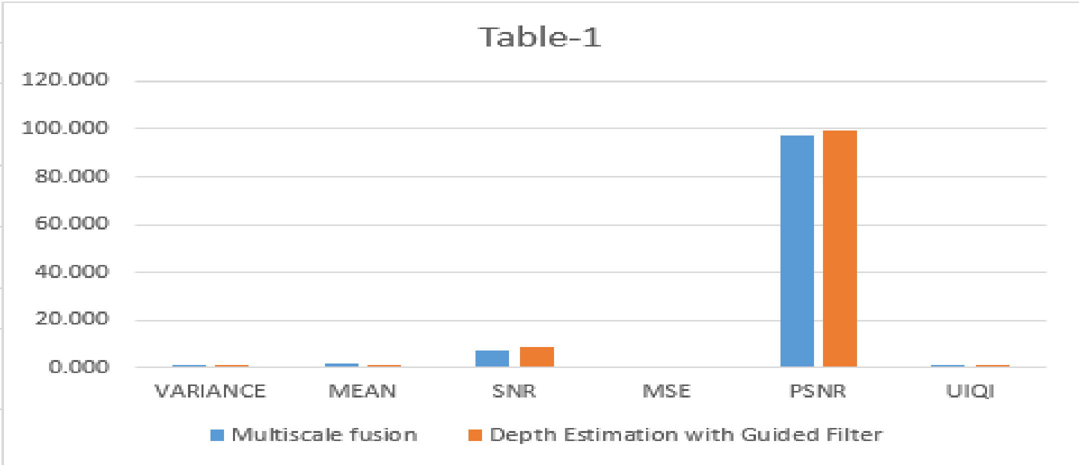


Figure 2: Comparison between Different Algorithms of haze removal for House image

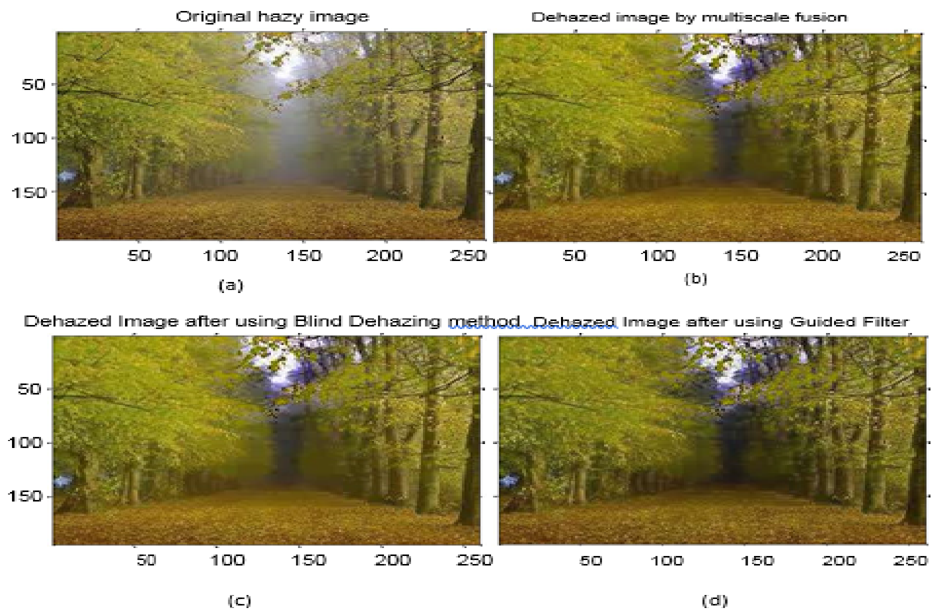


Figure:3 (a) Original Image, (b) Dehazed Image by using Multi scale Fusion (c) Dehazed Image by using Depth estimation Dehazing (d) Dehazed Image After Guided filter.

Table-2

METHOD	VARIANCE	MEAN	SNR	MSE	PSNR	UIQI
Multiscale fusion	1.034	1.391	7.117	0.005	113.660	0.818
Depth Estimation with Guided Filter	1.041	1.446	8.934	0.004	119.686	0.954

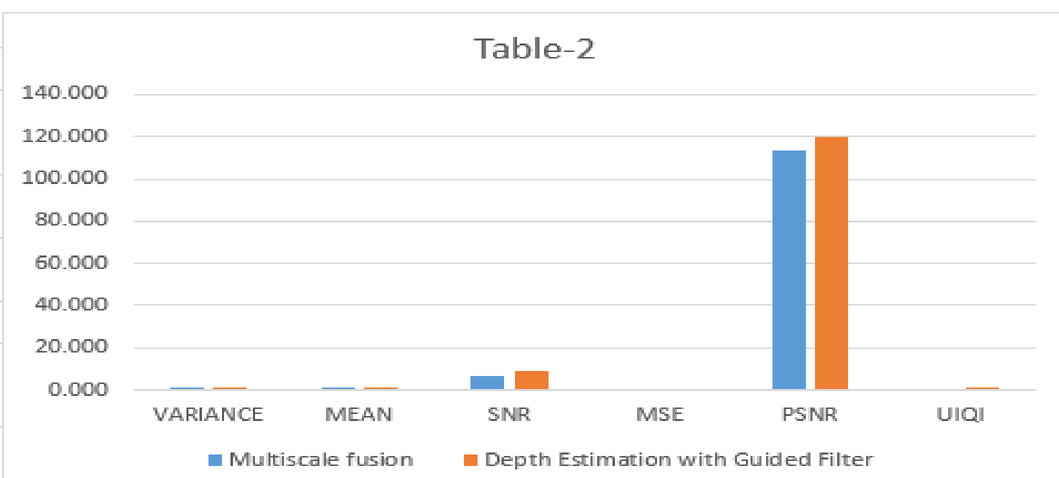


Figure 4: Comparison between Different Algorithms of haze removal for Park Image

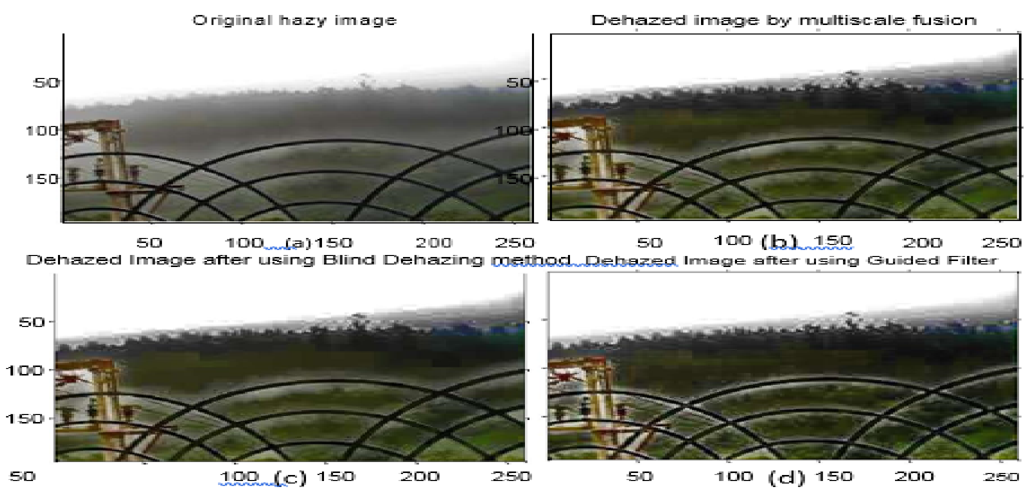


Figure: 5 (a) Original Image, (b) Dehazed Image by using Multi scale Fusion (c) Dehazed Image by using Depth estimation Dehazing (d) Dehazed Image After Guided filter.

Table 3:

METHOD	VARIANCE	MEAN	SNR	MSE	PSNR	UIQI
Multiscale fusion	1.104	0.332	6.536	0.006	119.081	0.564
Depth Estimation with Guided Filter	1.124	0.435	8.361	0.003	137.590	0.877

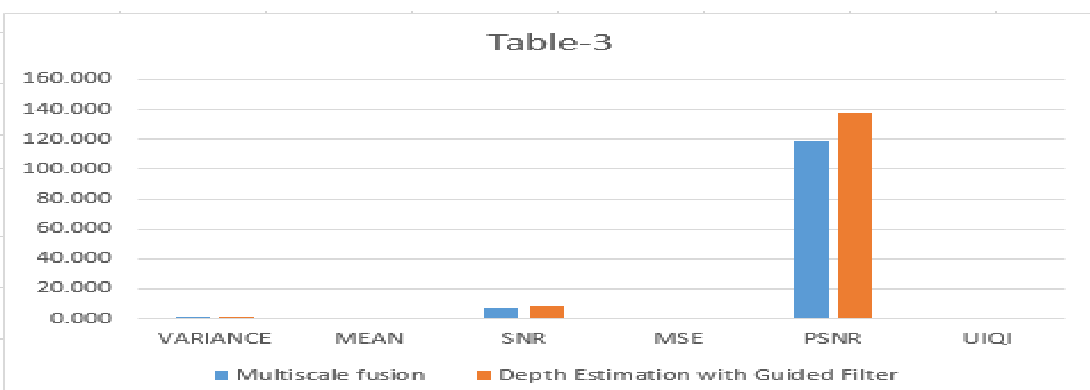


Figure 6: Comparison between Different Algorithms of haze removal of Hill image.

All the above graphs and table givethe comparison between old dehazing technique with our proposed dehazing technique. We have improved variance, means, SNR and UIQI which help us to get better performance on dehazing of images.

IV. Conclusion

In this paper, a fast and effective method for real-time image and video dehazing is proposed. Using a newly offered image preceding - dark channel prior, haze elimination for a single image without using any extra information is formulated as a filtering problem and an improved filtering scheme is proposed based on guided filter. In the presented algorithm, the air light and the down-sampled transmission can be estimated and extracted easily. Then using a guided filter, the transmission can be auxiliary advanced and up-sampled. Results show the presented method abilities to remove the haze layer and achieve real-time performance.

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