Abstract — Image processing techniques improve the quality of an image and enhance the maximum information from the degraded image. The proposed method adjusts the global contrast in the spatial domain for dehazing fog or haze spread over images and then enhances the local contrast in the transform domain for reviving the details of images. It is the process of combining two or more images into a single image; method is a fusion-based strategy that derives from two original hazy images inputs by applying a white balance and contrast enhancing procedure. The method performs in a pyramidal method, which is straightforward to implement. Then the resulting image will be more clear and enhanced from the prior.

I. INTRODUCTION

Image are degraded by the bad weather condition like fogs, ash volcanic ash, dust, smoke all these particle are provide obstacle in clearness of images. The quality of photograph in our daily life is easily undermined by the aerosols suspended in the medium, such as dust, mist, or fumes. This has an effect on the image, e.g., contrasts are reduced and the surface color becomes fad. Such degraded photographs often lack visual vividness and offer a poor visibility of the scene contents. The goal of haze removal algorithms is to enhance and recover the detail of the scene from haze image. There are many circumstances that accurate haze removal algorithms are needed. In computer vision, most automatic systems for surveillance, intelligent vehicles, object recognition, etc., assume that the input images have clear visibility. However, this is not always true in bad weather. In consumer photography, the presence of fog will be an annoyance to the images for it reduces the contrast significantly. Image fusion is the good information from each of the given images is fused together to form a resultant image whose quality is superior to any of the input images. This is achieved by applying a sequence of operators on the images that would make the good information in each of the image prominent.
windows to obtain a coarse estimate of the transmission map followed by a refinement step using an image matting technique. Their method obtains results on par with or exceeding other state-of-the-art algorithms, and is even successful with very hazy scenes.

A. Theoretical level

White balancing is an important processing step that aims to enhance the image appearance by discarding unwanted color casts caused by the atmospheric color. Due to the fact that haze is dominating the image, an average value is computed for the entire image. Similar as in [1], a straightforward biasing of the image average color towards pure white is employed. This step assures that atmospheric light color constant is equal to one and the normalized image values are in the range \([0, 1]\). As observed in [1], when the light color varies in the image it is more robust to perform this bias operation using the local average value, as shown in Fig. 2b. Practically, the first input of the fusion process is computed based on the straightforward white balancing operation. Nevertheless, white balancing solely is not able to solve the problem of visibility, and therefore an additional input is needed to enhance the contrast of the degraded image.

B. Weights of the Fusion

The design of the weight measures needs to consider the desired appearance of the restored output. Since image restoration is tightly correlated with the color appearance, so the measurable values such as haze density, salient features and exposedness are difficult to integrate by naïve per pixel blending. Higher values of the weight determine that a pixel is advantaged to appear in the final image.

Fig. 1. Pixel Pyramid Level

1) Pixel Level Fusion

This section focuses on the so-called pixel level fusion process, where a composite image has to be built of several input images[1]. In pixel-level image fusion, some generic requirements can be imposed on the fusion result:

a) The fusion process should preserve all relevant information of the input imagery in the composite image (pattern conservation)

C. Fusion Process

The images are first decomposed using a Laplacian Pyramid decomposition of the original image into a Hierarchy of images such that each level corresponds to a different band of image frequencies [1].

![Flowchart of dehazing the image of foggy images](image)

The Laplacian pyramid decomposition is a suitable MR decomposition for the present task as it is simple, efficient and better mirrors the multiple scales of processing in the HVS. The next step is to compute the Gaussian pyramid of the weight map. Blending is then carried out for each level separately [1] [2].
1) Inputs

In practice, there is no enhancing approach that is able to remove entirely the haze effects of such degraded inputs. Therefore, considering the constraints stated before, since we process only one captured image of the scene, the algorithm from the original image only two inputs that recover color and visibility of the entire image. The first one better depicts the haze-free regions while the second derived input increases

2) Weight Map

As can be seen in figures by applying only these enhancing operations, the derived inputs still suffer visible details of the hazy regions. Inherently inspired by the previous dehazing approaches such as Tan [11], Tarel and Hautiere [14] and He et al. [13], we searched for a robust technique that will properly white.

Table I. Calculation For PSNR, ERMS and Gray values

<table>
<thead>
<tr>
<th>Image</th>
<th>PSNR</th>
<th>ERMS</th>
<th>GRAY VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image 1</td>
<td>132.93</td>
<td>0.3314</td>
<td>0.8920</td>
</tr>
<tr>
<td>Image 2</td>
<td>144.28</td>
<td>1.1885</td>
<td>0.9843</td>
</tr>
<tr>
<td>Image 3</td>
<td>127.27</td>
<td>0.4393</td>
<td>0.6734</td>
</tr>
<tr>
<td>Image 4</td>
<td>139.55</td>
<td>0.2440</td>
<td>0.6121</td>
</tr>
<tr>
<td>Image 5</td>
<td>124.36</td>
<td>0.5095</td>
<td>0.5969</td>
</tr>
<tr>
<td>Image 6</td>
<td>129.63</td>
<td>0.8674</td>
<td>0.6121</td>
</tr>
<tr>
<td>Image 7</td>
<td>138.34</td>
<td>0.2533</td>
<td>0.5300</td>
</tr>
</tbody>
</table>

Table II. Entropy for Haze and Dehazed Image

<table>
<thead>
<tr>
<th>Image</th>
<th>Entropy of Haze images</th>
<th>Entropy of Dehazed images</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image 1</td>
<td>6.6718</td>
<td>6.7812</td>
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<tr>
<td>Image 2</td>
<td>6.4417</td>
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<td>Image 3</td>
<td>7.6177</td>
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<td>Image 4</td>
<td>7.3501</td>
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<td>Image 5</td>
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</tr>
<tr>
<td>Image 6</td>
<td>7.4844</td>
<td>7.5854</td>
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<tr>
<td>Image 7</td>
<td>7.2510</td>
<td>7.4372</td>
</tr>
</tbody>
</table>
D. Result and discussion

Prove the robustness of our method, the new operator has been tested on a large dataset of different natural hazy images. Haze due to dust, smoke and other dry particles reduces visibility for distant regions by causing a distinctive gray hue in the captured images. However, our technique has been successfully tested as well for a slightly different case: foggy scenes (e.g. the first and the third example in figure 6; the reader is referred also to the supplementary material for more cases). For our problem, fog has a similar impact as haze, but technically it appears as a dense cloud of water droplets close to the ground when night conditions are clear but cold, and the heat released by the ground is absorbed during the day (please refer to figure 12). We have shown that, by choosing appropriate weight maps and inputs, a multi-scale fusion strategy can be used to effectively dehaze images. Our technique has been tested on a large data set of natural hazy images. The method is faster than existing single image dehazing strategies and yields accurate results. In future work we would like to test our method on videos.

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