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Bi-orthogonal Wavelet Transform Based Single Image Visibility Restoration on Hazy Scenes

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ABSTRACT:-

The hazy removal technique divided into three categories such additional information approaches, multiple image approaches, single-image approaches. The first two methods are expense one and high computational complexity. Recently single image approach is used for this de-hazing process because of its flexibility and low cost. The dark channel prior is to estimate scene depth in a single image and it is estimated through get at least one color channel with very low intensity value regard to the patches of an image. The transmission map will be estimated through atmospheric light estimation. The median filter and adaptive gamma correction are used for enhancing transmission to avoid halo effect problem. Then visibility restoration module utilizes average color difference values and enhanced transmission to restore an image with better quality.

Keywords: - *Hazy Image, Contrast Stretching, Bi-orthogonal Wavelet Transform, Depth Estimation, Adaptive Gamma Correction, Color Analysis, Visibility Restoration*

INTRODUCTION:-

The project presents visibility restoration of single hazy images using color analysis and depth estimation with enhanced on bi-orthogonal wavelet transformation technique. Visibility of outdoor images is often degraded by turbid mediums in poor weather, such as haze, fog, sandstorms, and smoke. Optically, poor visibility in digital images is due to the substantial presence of different atmospheric particles that absorb and scatter light between the digital camera and the captured object. The restoration model is proposed with utilization of median filter and adaptive gamma correction technique and dark channel prior method. This approach overcomes the problems such as color distortion, artifacts and insufficient depth information. The hazy removal technique divided into three categories such additional information approaches, multiple image approaches, single-image approaches. The first two methods are expense one and high computational complexity. Recently single image approach is used for this de-hazing process because of its flexibility and low cost. The restoration model is proposed with utilization of median filter and adaptive gamma correction technique and dark channel prior method. This approach overcomes the problems such as color distortion, artifacts and insufficient depth information. The dark channel prior is to estimate scene depth in a single image and it is estimated through get at least one color channel with very low intensity value regard to the patches of an image. The transmission map will be estimated through atmospheric light estimation. The median filter and adaptive gamma correction are used for enhancing transmission to avoid halo effect problem.

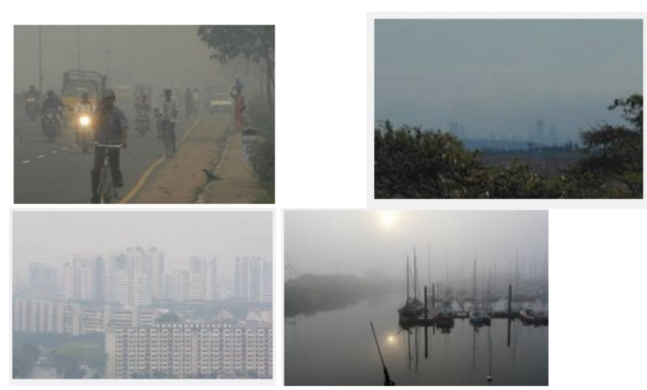

Figure: Image De-Haze Process on Contrast Enhancement

However, besides the geometric and photometric variations, outdoor and aerial images that need to be matched are often degraded by the haze, a common atmospheric phenomenon. Obviously, remote sensing applications are dealing with such images since in many cases the distance between different sensors and the surface of earth is significant. Haze is the atmospheric phenomenon that dims the clarity of an observed scene due to the particles such as smoke, fog, and dust. A hazy scene is characterized by an important attenuation of the color that depends proportionally by the distance to the scene objects. As a result, the original contrast is degraded and the scene features gradually fades as they are far away from the camera sensor.

EXISTING METHOD ANALYSIS:-

Laplacian Pyramid

Laplacian-based gamma correction technique is proposed to flexibly refine the insufficient transmission map. To this end, we initially adopt the color cast detection technique to examine whether color cast problems exist in the incoming hazy image.

In Existing Method, HTE module is first employed via a combination of the Laplacian distribution model
And gamma correction technique to refine the transmission map for overcoming the insufficient estimation of haze thickness. Next, the proposed IVR module is utilized, which is based on a combination of the Laplacian distribution model and white patch-Retinex theory to estimate the adjustable color parameters of the hazy image and further overcome color cast problems in the restoration result. Finally, a haze-free image can be generated by using the refined transmission map and the estimated adjustable color parameters to adequately remove atmospheric particles from hazy images.

Retinex Theory:-

The term retinex is a word he coined combining the words retina and cortex. The retina is the part of the eye that detects color, and the visual cortex is the part of your brain that processes the information it receives from the retina. The level of ambient light can change the appearance of colors. Let's say you take two photographs of a red house, one in full sunlight and the other on a very cloudy day. If you look at the photos side by side you will see that the color of the house appears different.

To avoid color cast problems in restored images, we employthe Laplacian-based white patch-Retinex technique to effectivelyrecover true scene color in sandstorm images becausethe white patch-Retinex theory is well-suited for images withinsufficient amounts of color variations according to [33]. Tothis end, we combine information of both the Laplacian distributionvalues and the white patch-Retinex theory to estimatethe adjustable color parameters in enhanced image.

PROPOSED METHOD ANALYSIS:-

Hazy Image:-

In this paper, we propose a novel prior - dark channel prior, for single image haze removal. The dark channel prior is based on the statistics of haze-free outdoor images. We find that, in most of the local regions which do not cover the sky, it is very often that some pixels (called ”dark pixels”) have very low intensity in at least one color (RGB) channel. In the haze image, the intensity of these dark pixels in that channel is mainly contributed by the airlight. Therefore, these dark pixels can directly provide accurate estimation of the haze’s transmission. Combining a haze imaging model and a soft matting interpolation method, we can recover a hi-quality haze-free image and produce a good depth map (up to a scale).

Color Analysis

There are a wide variety of approaches to analyzing personal coloring. The most well-known is "seasonal" color analysis, which places individual coloring into four general categories: Winter, Spring, Summer and Autumn. More recent systems subdivide the seasons into 12 or 16 categories. Many different versions of seasonal analysis have been developed and promoted by image and color

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consultants worldwide. Some color analysis systems classify an individual's personal combination of hair color, eye color and skin tone using labels that refer to a color's “temperature” (cool blue vs. warm yellow) and the degree to which the hair, skin and eye colors contrast.

The term atmospheric light will be estimated from dark channel of hazy image.It is the brightest 0.1% of pixels within a dark channel and from these one, the highest intensity pixels are chosen from RGB planes of hazy image as a atmospheric light.The dark channel prior is estimated by minimum filter which applies on input image. It is based on key concept that hazy free images have at least one color channel with low intensity values.

It is used to determine the transmission map and it is expressed by,

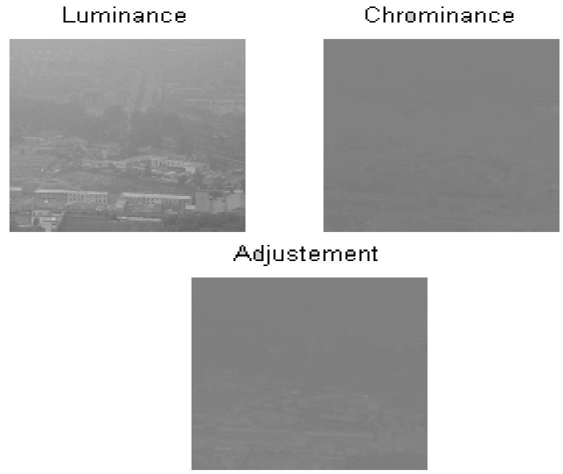
$J_{dark} = min(min(I(x))$

Where, min(I(x)) finds minimum value among each point of RGB and second min filter gives minimum of local patch.

RGB image of class unit8 and double and converts it to an YCBCR image. The transformation formula is below.

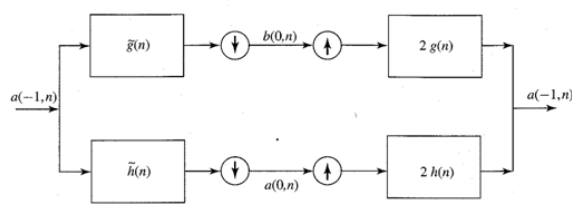
$$Y' = 16 + (65.481 \cdot R' + 128.553 \cdot G' + 24.966 \cdot B')$$
$$C_B = 128 + (-37.797 \cdot R' - 74.203 \cdot G' + 112.0 \cdot B')$$
$$C_R = 128 + (112.0 \cdot R' - 93.786 \cdot G' - 18.214 \cdot B')$$

Color plane separation is very useful in processing color document images. Many reported methods take it as a multi-class classification problem and work not well in overlapped color regions. This paper proposed a simple but effective linear projection based method for separating overlapped color planes. The separation task is taken as a probability problem, i.e., in the output plane, target color should have high response and the other colors should have low response, or vice versa. Furthermore, it assumes that the number of foreground colors is low, typically one to four, and overlapped areas contain mixed colors instead of opaque covering.



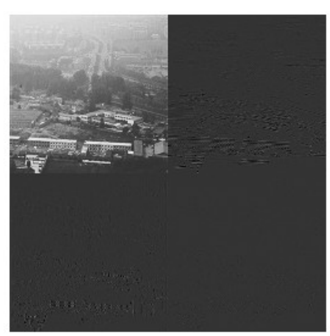
Bi-orthogonal Wavelet Transform

Decomposition and reconstruction filters are FIR and have the same length. Generally do not have closed-form expressions.



Haar wavelet is the only real-valued wavelet that is compactly supported; symmetric and orthogonal Higher-order filters (with more coefficients) have poor time-frequency localization. Delegate the responsibilities of *analysis* and *synthesis* to two different functions (in the bi-orthogonal case) as opposed to a single function in the ortho-normal case

$$\phi(t) = 2\sum_{n=-\infty}^{\infty} h(n)\phi(2t-n) \qquad \tilde{\phi}(t) = 2\sum_{n=-\infty}^{\infty} \tilde{h}(n)\tilde{\phi}(2t-n)$$
$$\langle \phi(t), \tilde{\phi}(t-k) \rangle = \delta(k) \qquad \langle \phi(2^{-k}t), \tilde{\phi}(2^{-k}t-n) \rangle = 2^{k}\delta(n)$$



Color Depth Estimation:-

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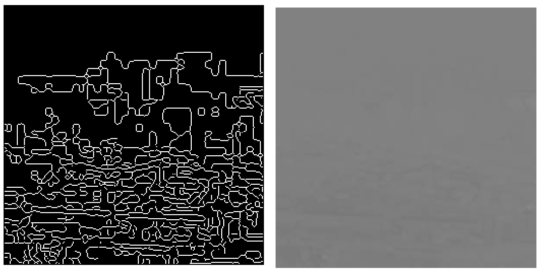
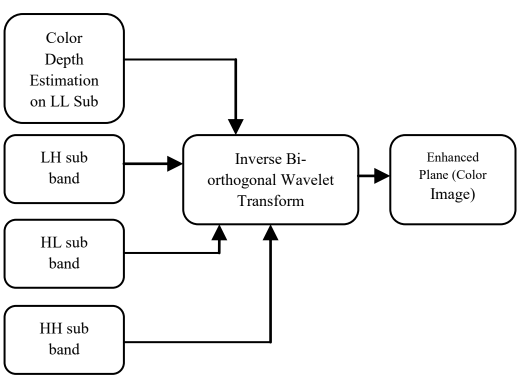
We consider the task of depth estimation from a single monocular image. We take a supervised learning approach to this problem, in which we begin by collecting a training set of monocular images (of unstructured outdoor environments which include forests, trees, buildings, etc.) and their corresponding ground-truth depthmaps.



Then, we apply supervised learning to predict the depthmap as a function of the image. Depth estimation is a challenging problem, since local features alone are insufficient to estimate depth at a point, and one needs to consider the global context of the image.

Inverse Bi-orthogonal Wavelet Transform:-

Wavelets can be orthogonal (ortho-normal) or bi-orthogonal. The bi-orthogonal wavelet transform is an invertible transform. The property of perfect reconstruction and symmetric wavelet functions exist in bi-orthogonal wavelets because they have two sets of low pass filters (for reconstruction), and high pass filters (for decomposition). One set is the dual of the other. On the contrary, there is only one set in orthogonal wavelets. In bi-orthogonal wavelets, the decomposition and reconstruction, filters are obtained from two distinct scaling functions associated with two multi-resolution analyses in duality.



Inverse Biorthogonal Wavelet Decomposition

Adaptive Gamma Correction:-

In proposed an efficient method to modify histograms and enhance contrast in digital images. Enhancement plays a significant role in digital image processing, computer vision, and pattern recognition. We present an automatic transformation technique that improves the brightness of dimmed images via the gamma correction and probability distribution of luminance pixels.

Visibility Restoration:-

One source of difficulties when processing outdoor images is the presence of haze, fog or smoke which fades the colors and reduces the contrast of the observed objects. We introduce a novel algorithm and variants for visibility restoration from a single image.

The main advantage of the proposed algorithm compared with other is its speed: its complexity is a linear function of the number of image pixels only. This speed allows visibility restoration to be applied for the first time within real-time processing applications such as sign, lane-marking and obstacle detection from an in-vehicle camera. Another advantage is the possibility to handle both color images or gray level images since the ambiguity between the presence of fog and the objects with low color saturation is solved by assuming only small objects can

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have colors with low saturation. The algorithm is controlled only by a few parameters and consists in: atmospheric veil inference, image restoration and smoothing, tone mapping. A comparative study and quantitative evaluation is proposed with a few other state of the art algorithms which demonstrates that similar or better quality results are obtained.

Conclusion:-

In Our Existing Method they done work on COlour Depth Estimation based hazy scene removal , contraststretching on histogram equalization and resolution enhancement purpose wavelet transform.in visibility restoration purpose weather mapping process on multispectral images analysis.In Proposed method we done modification work on hazy scene removal on dark channel prior is to estimate scene depth in a single image and it is estimated through get at least one color channel with very low intensity value regard to the patches of an image. The transmission map will be estimated through atmospheric light estimation. The median filter and adaptive gamma correction are used for enhancing transmission to avoid halo effect problem. Then visibility restoration module utilizes average color difference values and enhanced transmission to restore an image with better quality.

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