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Image Deblurring with Color Depth Estimation and Visibility Restoration

Mohd Muzaffar Hussain
M.Tech Scholar
Vijay Rural Engineering College

G. Swetha
Assistant Professor
Vijay Rural Engineering College

Dr.B.R.Vikram
Professor and Principal
Vijay Rural Engineering College

ABSTRACT:

In the fog and haze climatic condition, the captured picture will become blurred and the color is partial gray and white, due to the effect of atmospheric scattering. we propose a fast haze removal algorithm which based on a fast bilateral filtering combined with dark channel prior. This algorithm has a fast execution speed and greatly improves the original algorithm which is more time-consuming. A novel VR method that uses a combination of three major modules: 1) a depth estimation (DE) module; 2) a color analysis (CA) module and 3) a VR module. The proposed DE module takes advantage of the median filter technique and adopts our adaptive gamma correction technique. By doing so, halo effects can be avoided in images with complex structures, and effective transmission map estimation can be achieved. The proposed CA module is based on the gray world assumption and analyzes the color characteristics of the input hazy image. The VR module uses the adjusted transmission map and the color-correlated information to repair the color distortion in variable scenes captured during inclement weather conditions. Experimental-results show that this algorithm is feasible which effectively restores the contrast and color of the scene, significantly improves the visual effects of the image.

Keywords:- Hazy Image, Blur, 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 bi-orthogonal wavelet transformation technique. The restoration model is proposed with utilization of median filter and adaptive gamma correction technique and dark channel prior method. 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. 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.

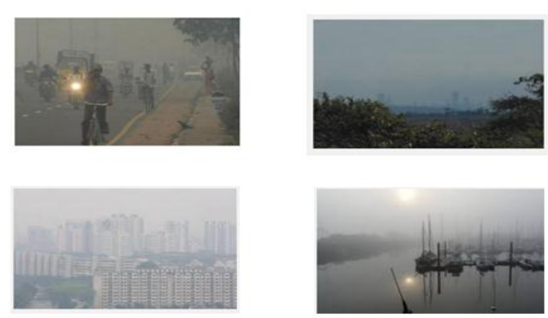

Figure 1: Image De-blurring Process on Contrast Enhancement

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. Haze is the atmospheric phenomenon that dims the clarity of an observed scene due to the particles such as smoke, fog, and

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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:

Image Denoising:

Image noise is the random variation of brightness or color information in images produced by the sensor and circuitry of a scanner or digital camera, it can also originate in film grain. Image noise is generally regarded as an undesirable byproduct of image capture. Image denoising is an important image processing task, both as a process itself, and as a component in other processes. The main properties of a good image denoising model is that it will remove noise while preserving edges. Traditionally, linear models have been used. One common approach is to use a Gaussian filter, or equivalently solving the heat-equation with the noisy image as input-data. One big advantage of linear noise removal models is the speed, but a drawback of the linear models is that they are not able to preserve edges. Nonlinear models on the other hand can handle edges in a much better way than linear models.

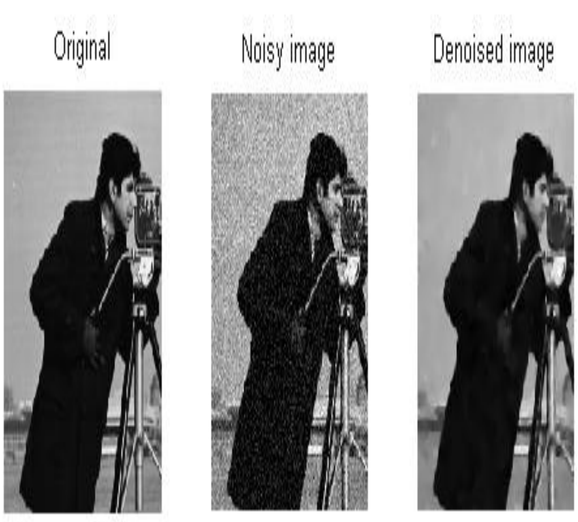

Figure 2: Image Denoising

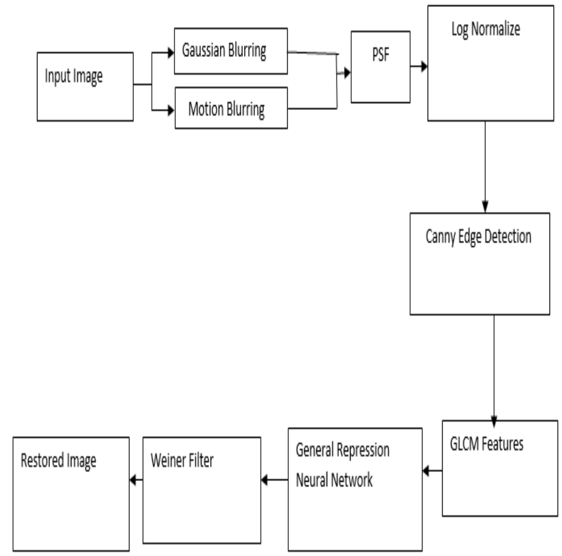

Figure 3: Block Diagram

Generalized Regression Neural Network:

GRNN is a variation to radial basis neural network. GRNN represents an improved technique in the neural networks based on the non parametric regression. The main function of a GRNN is to estimate a chance density function of the input independent variables and also the output. GRNN consists of an input layer, a hidden layer, "unnormalized" output units, a summation unit, and normalized outputs. GRNN is trained utilizing a one-pass learning algorithm without any iterations. Intuitively, in the training process, the target values for the training vectors facilitate to define cluster centroids, that act as part of the weights for the summation units.

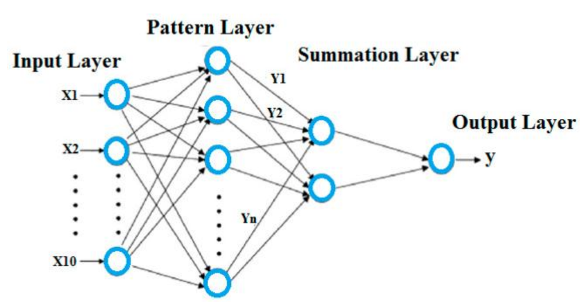

Figure 4: GRNN Architecture

Wiener Filter:

The most important technique for removal of noise in images due to linear motion or unfocussed optics is the Wiener filter. From a signal processing standpoint, noise due to linear motion in a photograph is the result of poor sampling. Each pixel in a digital representation of the photograph should represent the intensity of a single stationary point in front of the camera.

G(u,v)=F(u,v).H(u,v)

where F is the fourier transform of an "ideal" version of a given image, and H is the noise function. Ideally one could reverse-engineer a Fest or F estimate, if G and H are known. This technique is inverse filtering. There are two problems with this method. First, H is not known precisely. Second, inverse filtering fails in some circumstances because the sinc function goes to 0 at some values of x and y. The best method to solve the second problem is to use Wiener filtering. This tool solves an estimate for F according to the following equation:

Fest(u,v)=|H(u,v)|^2.G(u,v)/(|H(u,v)|^2.H(u,v)+K(u,v))

PROPOSED METHOD ANALYSIS:

Dark Channel Prior:

The dark channel prior is relies on the statistics of blur-free outdoor images. We find that, in most of the local regions which do not cover the sky, it's fairly often that some pixels (called "dark pixels") have very low intensity in at least one color (RGB) channel. Within 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).

Median Filter:

The Median Filter is performed by taking the magnitude of all of the vectors within a mask and sorted according to the magnitudes. The pixel with the median magnitude is then used to replace the pixel studied. The Simple Median Filter has an advantage over the Mean filter since median of the data is taken instead of the mean of an image. The pixel with the median magnitude is then used to replace the pixel studied. The median of a set is more robust with respect to the presence of noise. It is used for enhancing transmission to avoid halo effect. The median filter is given by

r(x1…xN)=Median(||x1||2……||xN||2)

Color Analysis:

There are a wide variety of approaches to analyzing personal coloring. The most well-known is "seasonal" color analysis. 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 blur 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.

Figure 5: Hazy Image

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

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

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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.

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

Color plane separation is very useful in processing color images. 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.

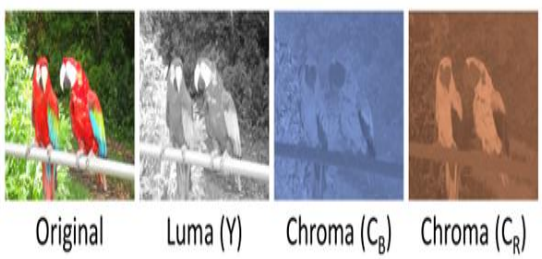

Figure 6: Color Analysis

Visibility Restoration:

We introduce a novel algorithm and variants for visibility restoration from a single image.

Figure 7: Visibility Restoration

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. The algorithm is controlled only by a few parameters and consists in: atmospheric veil inference, image restoration and smoothing, tone mapping. The visibility restoration module uses average color distinction values and increased transmission to give higher quality image.

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.

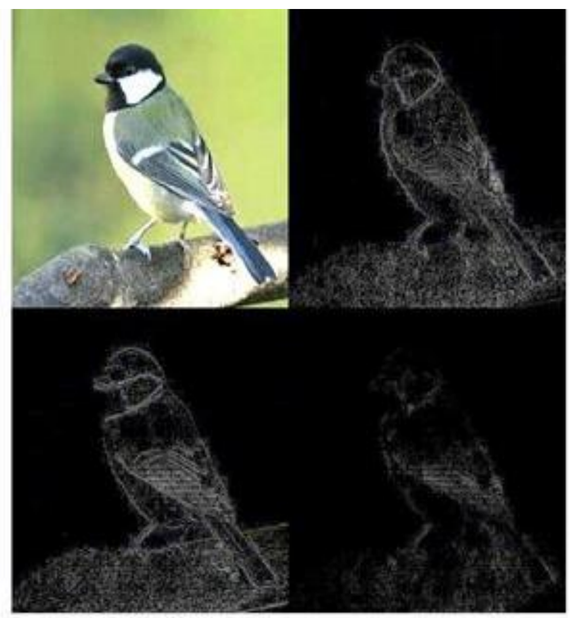

Figure 8: Wavelet Transform

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

$$\phi(t) = 2\sum_{n=-\infty}^{\infty} h(n)\phi(2t-n) \qquad \tilde{\phi}(t) = 2\sum_{n=-\infty}^{\infty} \tilde{h}(n)\tilde{\phi}(2t-n)$$

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$$\left\langle \phi(t), \tilde{\phi}(t-k) \right\rangle = \delta(k) \quad \left\langle \phi(2^{-k}t), \tilde{\phi}(2^{-k}t-n) \right\rangle = 2^{k}\delta(n)$$

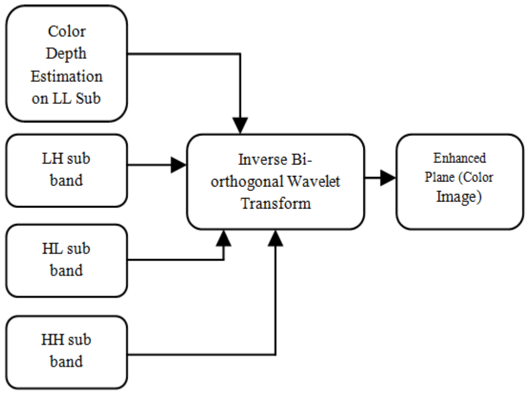

Figure 9: Changed Bi-orthogonal Wavelet Transform

Color Depth Estimation:

The depth of image is conventionally defined as the distance between the corresponding scene point of the image and the pinhole of the camera, which is not harmony with the depth perception of human vision. So far, various methods for depth estimation have been proposed method of stereopsis, Depth From Focus(DFF) method and Depth estimation algorithm

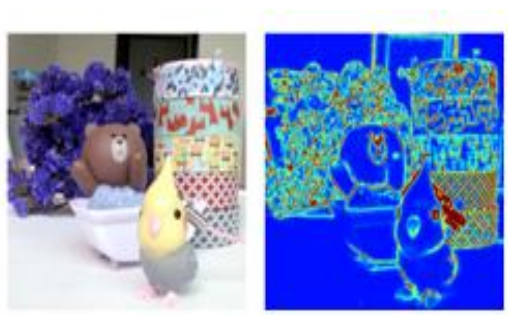

Figure 10: Color Depth Estimation

Then, we apply supervised learning to predict the depth map 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.

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. It is used for enhancing transmission to avoid halo effect.

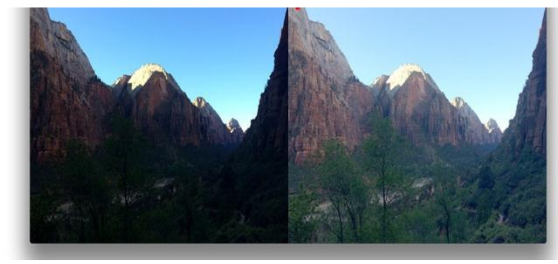

Figure 11: Adaptive Gamma Correction

Conclusion:

In Our Existing Method they done work on Colour Depth Estimation based blur removal, contraststretching on histogram equalization and resolution enhancement purpose wavelet transform. In Proposed method we done modification work on blur 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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