ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

An Alternative Technique for Improving Image Quality in Poor Visibility Condition for Traffic Monitoring Image

P.T.Hemalatha
PG scholar,
Department of ECE,
Sri Venkatesa Perumal College of Engineering Technology, Puttur.

Mr.S.Venkata Kiran, M.Tech
Associate Professor,
Department of ECE,
Sri Venkatesa Perumal College of Engineering Technology, Puttur.

ABSTRACT:

In daylight viewing conditions, image contrast is often significantly degraded by atmospheric aerosols such as haze ,fog and mist .This type of weather conditions leads to image color distortion ,reduce the resolution and the contrast of the observed object in outdoor scene acquisition. In order to detect and remove fog,an improved fog removing methods proposed here is to make the image quality more clear and easy to recognize. First, the Retinex method is an image enhancement algorithm which is used to enhance the image quality with dynamic range compression and the wavelet transform algorithm is added to it to suppress the low frequency of the image and in turn enhance the high frequency information in order to get the details of the image and also reduces the noise in the image, finally a clear image with fog removed is obtained. This proposed algorithm is better than other traditional algorithms such as Retinex and Dark Channel. It is more suitable for fog, haze and mist weather image enhancement; especially improves the processing effect on fog weather's vehicle detection and license plate recognition. Using Retinex and wavelet transform algorithm processing,we not only restore the most of the image information, but also reduce the noise of the image.

IndexTerms:

foggy image, Retinex algorithm, Wavelet algorithm.

1. INTRODUCTION:

Recent years, haze weather became very serious in China. This kind of common weather phenomena will produce whitening effect, will cause the image to degenerate, even fuzzy, which will bring the serious influence for the transportation system and the outdoors vision system. Therefore, there is a new requirement to deal with the fog image clarity and realistic. With the continuous development of computer hardware and software technology, it became possible to remove fog from the massive. images. Nowadays, there are several representative algorithms for fog-removing proposal. Land first proposed the idea of Retinex as a model of lightness and color perception of the human vision. Obviously it is not only a model, but also could be developed to algorithms of image enhancement.

The Global Image Contrast Enhancement Method:

Global fog image enhancement method refers to the adjustment of the grey value is determined by the statistical information of whole fog image. There has no any relation with the adjustment point of the region. Such as Brian Eriksson take advantage of the curvelet transform to automatic remove fog using the vanishing point detection based on curvelet. But the disadvantage of the algorithm is only relative to improve the quality of images, not in the true sense of removing fog from image.

Retinex algorithm is a model describing the color invariance, it has the characteristics of dynamic range compression and color invariance, caused by uneven illumination and low contrast color image has very good effect. Retinex has taken the great attention by researchers in recent years, including Single Scale Retinex algorithm (Single Scale Retinex, SSR) and multiscale Retinex algorithm (Multi-scale Retinex, MSR) application has achieved great success. The lack of this algorithm is the image detail is not obvious.

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The Methods Based on The Depth Relationship of Fog Image Restoration:

Reduce the depth information of image is an important clue to restoration of fog images. According to the scene depth information is known, this recovery methods can be divided into two categories. One method is assumed scene depth information is known. This method firstly suggested. by Oakley. Another method is to use the auxiliary information extraction method. Interactive depth estimation algorithm and the known 3D model to get the scene depth, such as the Kopf method is to obtain the depth of field using the known 3D model, so as to recover the fog image. However this algorithm also has disadvantages: firstly the 3D model conditions are very serious, and this algorithm is not automatic, it is difficult to be run in real time.

Image Restoration Based on Prior Information:

Many researchers focus on how to solve completely removing fog for signal image according to the variation in the fog concentration. In this early work was done by Tan. Moreover, Fattal and others under the assumption that the transmission of light is local not related with and the scene target surface shading part, to estimate the scene irradiance, and thus derived the propagation image. In this paper an improved fog removing method for the traffic monitoring image, which combining Retinex algorithm and wavelet transform algorithm is proposed.

2. Proposed Method:

2.1.Retinex Algorithm:

Retinex algorithm has showed good effect on removing fog from image. Retinex algorithm is to reduce the effects of incident light on the image, and to strengthen the reflection image as follows:

$$RI(x, y) = \log Il(x, y) - \log [F(x, y) * Il(x, y)] \quad I = 1, \ldots, n \qquad (1)$$

RI(x,y) is the output corresponding to the L channel, II (x, y) is an input luminance image pixel value of the L channel, the parameter * is the convolution operation, the parameter n in the color channel number, F (x, y) represents the center / surround function, it is represented by Gauss function as formulation (2).

$$F(x,y) = Ke^{-\frac{x2+y2}{\sigma 2}} \qquad (2)$$

The parameter σ controls center / surround function range, the value is smaller, the center /surround function is sharper.The Retinex is a member of the class of center/surround functions where the center is defined as each pixel value and the surround is defined as a Gaussian function. Expressed mathematically, the single-scale, monochromatic Retinex is defined by

$$R(x_1, x_2) = \alpha^i \log(I(x_1, x_2)) - \log(I(x_1, x_2) * F(x_1, x_2))^{¢} - \beta \qquad (3)$$

Where I is the input image, R is the Retinex output image, log is the natural logarithm function, and α and β are scaling factors and offset parameters respectively, that transform and control the output of the log function. The ∗ symbol represents convolution. F is a Gaussian filter (surround or kernel) defined by

$$F(x_1,x_2) = \kappa \exp[-(x^2_1 + x^2_2)/\sigma^2] \qquad (4)$$

Where σ is the standard deviation of the filter and controls the amount of spatial detail that is retained, and κ is a normalization factor that keeps the area under the Gaussian curve equal to 1. Color constancy is also a direct result of the center/surround form of the algorithm. As an approximation, the intensity value, I, can be expressed as the product of an illuminant component i, and a reflectance component ρ

$$I(x_1, x_2) = i(x_1, x_2)\rho(x_1, x_2) \qquad (5)$$

Since the illumination i varies slowly across the scene, Several extensions of the basic Retinex have been defined. This includes the multi-spectral, multi-scale Retinex (MSR) with color restoration (MSRCR), and recently the addition of post-processing with a white balance technique for improved color restoration.

For this effort we consider the single-scale version of the algorithm.

Control Parameters For Retinex:

The recently published Matlab Implementation of the Retinex Algorithm has free parameters for the user to specify. For Retinex to be useful as a model of human perception, these parameters must be determined. The parameters include the number of iterations to perform at each spatial scale, the viewing angle, image resolution, and the lookup table function (post-lut) to be applied upon completion of the main retinex computation. These parameters were specifically left unspecified in since the previous descriptions of retinex upon which the new Matlab implementations were based do not define them.

2.2 Discrete wavelet transform algorithm:

2-D discrete wavelet transform algorithm is a well-known method for image processing. The discrete wavelet transform (DWT) is an implementation of the wavelet transform using a discrete set of the wavelet scales and translations obeying some defined rules. In other words, this transform decomposes the signal into mutually orthogonal set of wavelets, which is the main difference from the continuous wavelet transform (CWT), or its implementation for the discrete time series sometimes called discrete-time continuous wavelet transform (DT-CWT). The wavelet can be constructed from a scaling function which describes its scaling properties. The restriction that the scaling functions must be orthogonal to its discrete translations implies some mathematical conditions on them which are mentioned everywhere, e.g. the dilation equation

$$\emptyset(x) = \sum_{k=-\infty}^{\infty} a_k \, \emptyset(S_x - k)$$

Where S is a scaling factor (usually chosen as 2). Moreover, the area between the function must be normalized and scaling function must be orthogonal to its integer translations, i.e.

$$\int_{-\infty}^{\infty} \emptyset(x)\emptyset(x + l)dx = \delta_{0,l}$$

After introducing some more conditions (as the restrictions above does not produce a unique solution) we can obtain results of all these equations, i.e. the finite set of coefficients a_k that define the scaling function and also the wavelet. The wavelet is obtained from the scaling function as N ,where N is an even integer. The set of wavelets is then forms an orthonormal basis which we use to decompose the signal. Note that usually only few of the coefficients a_k are nonzero, which simplifies the calculations. There are several types of implementation of the DWT algorithm. The oldest and most known one is the Mallat (pyramidal) algorithm. In this algorithm two filters – smoothing and non-smoothing one – are constructed from the wavelet coefficients and those filters are recurrently used to obtain data for all the scales. If the total number of data $D = 2^N$ is used and the signal length is L, first D/2 data at scale $L/2^{N-1}$ are computed, then (D/2)/2 data at scale $L/2^{N-2}$, …up to finally obtaining 2 data at scale L/2.

The result of this algorithm is an array of the same length as the input one, where the data are usually sorted from the largest scales to the smallest ones. Within Gwyddion the pyramidal algorithm is used for computing the discrete wavelet transform. Discrete wavelet transform in 2D can be accessed using DWT module. Discrete wavelet transform can be used for easy and fast denoising of a noisy signal. If we take only a limited number of highest coefficients of the discrete wavelet transform spectrum, and we perform an inverse transform (with the same wavelet basis) we can obtain more or less denoised signal. There are several ways how to choose the coefficients that will be kept. Within Gwyddion, the universal thresholding, scale adaptive thresholding and scale and space adaptive thresholding is implemented. For threshold determination within these methods we first determine the noise variance guess given by

$$\hat{\sigma} = \frac{\text{Median } |Y_{ij}|}{0.6745}$$

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Where Y_{ij} corresponds to all the coefficients of the highest scale subband of the decomposition (where most of the noise is assumed to be present). Alternatively, the noise variance can be obtained in an independent way, for example from the AFM signal variance while not scanning. For the highest frequency subband (universal thresholding) or for each sub band (for scale adaptive thresholding) or for each pixel neighbourhood within subband (for scale and space adaptive thresholding) the variance is computed as

$$\hat{\sigma}_Y^2 = \frac{1}{n^2} \sum_{i,j=1}^{n} Yij^2$$

Threshold value is finally computed as

$$T(\hat{\sigma}_X) = \hat{\sigma}^2 / \hat{\sigma}_X$$

Where $\hat{\sigma}_X = \sqrt{\max(\hat{\sigma}_Y^2 - \hat{\sigma}^2, 0)}$

When threshold for given scale is known, we can remove all the coefficients smaller than threshold value (hard thresholding) or we can lower the absolute value of these coefficients by threshold value (soft thresholding).

2.3.The Improved Fog-Removing Method:

An improved fog-removing method which has combined the merits of Retinex algorithm and Wavelet transform algorithm. This improved fog-removing method firstly use Retinex algorithm to enhance the image and then wavelet image enhancement method is used to get details of the image, finally a clear image with fog-removed is obtained.

3. Simulation Result:

Output of Existing Method

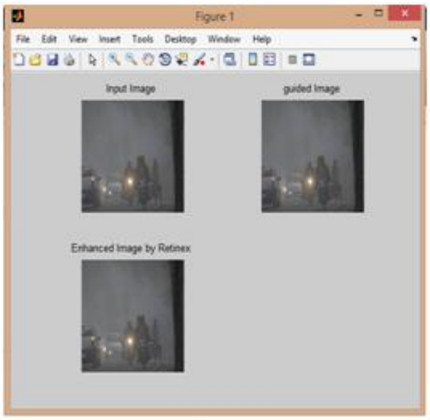

Fig:1 Input image,Guided image,Enhanced image by Retinex

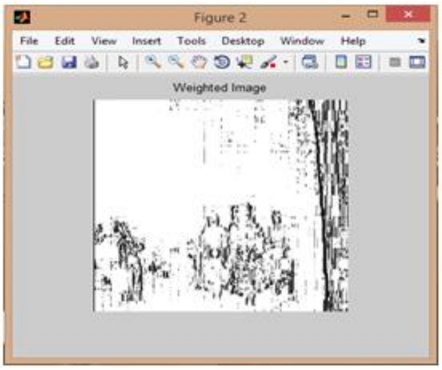

Fig:2 Weighted Image

Now a day's fog is a major issue to determine exact object infront of us .There are many techniques are available. In those techniques fog removal is done partially by using retinex algorithm. Fig.1 shows the input image, guided image, enhanced image by retinex. So in order to remove fog we are going to identify the weighted area in the input image as shown in Fig.2.

Output of Proposed Method:

The output of the proposed method is shown in the Fig.3.

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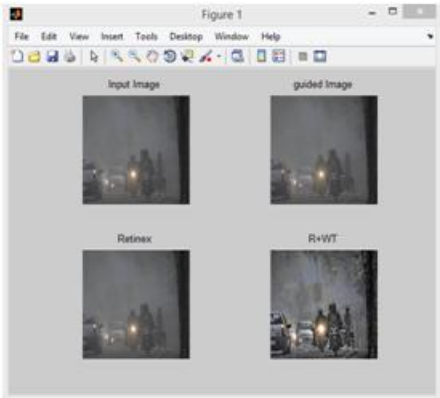

Fig.3 Input image,Guided image,Retinex,R+wt

Here we are going to apply retinex with wavelet transform algorithm .First use retinex algorithm to enhance the image ,then wavelet transform algorithm is used to enhance the detail of the image ,finally clear image which are removed fog can be obtained by suppressing low frequency information of the image which is shown in Fig.3. Here fog removal is efficient compare to the existing method.

Extension Output:

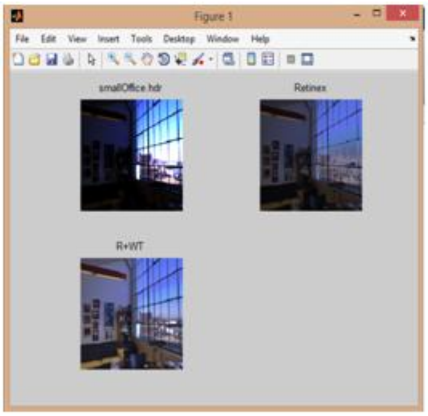

Fig.4 Smalloffice.hdr,Retinex,R+wt

Now in as an extension, when we remove the fog it losses some features of an original image .It is also a drawback to us. So to retain our original features of an image we are going to apply Retinex and wavelet transform algorithm simultaneously at a time to a given input image.

ADVANTAGES:

- Image enhancement is an automatic process independent of inputs.
- Has general application on all pictures.
- Good dynamic range compression and color rendition effect.
- Clarity of image is high
- Identification and authentication
- Reduces the noise of the image.
- Improve the processing effect on fog weather's vehicle detection and license plate recognition.
- Retinex and wavelet transform method is more suitable for the fog haze weather image enhancement.

APPLICATIONS:

1. Image sharpening and restoration
2. Color processing

CONCLUSION:

There have been significant advances in the area of image enhancement, denoising, vehicle detection and license plate recognition .In this thesis a unique and effective method for foggy image enhancement have been presented. The design of an enhancement algorithm should serve a particular application area and is the crucial factor in obtaining a better simulation results. In the area of foggy image enhancement, both luminance and chrominance components play an important role. Therefore ,the proposed method chooses the retinex and wavelet algorithms to deal with the luminance and chrominance components. First, the Retinex algorithm is used to enhance the image quality and then wavelet transform algorithm is used to enhance details of the image, finally a clear image with fog removed is obtained.However the simulation results shows that the proposed method can effectively increase the definition of a foggy image. Comparing with the traditional algorithm such as retinex and dark channel, the new algorithm proposed in this thesis involves less computations and relatively simple to implement.

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FUTURE SCOPE:

In future one can use the same Retinex and wavelet transform method to remove fog in traffic video so as to help the traffic monitoring.

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