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An Efficient Fog Removal Method Using Retinex and DWT Algorithms

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Abstract:
In this paper, we proposed an improved fog-removing method in order to make the images becoming clearer and easier to recognition. The proposed method combines the Retinex algorithm and wavelet transform algorithm. The proposed method firstly use Retinex algorithm to enhance the image, then the wavelet transform algorithm is used to enhance the details of the image, finally a clearly image which are removed fog can be obtained after reduce the non-important coefficients. Through analyzing the PSNR (Peak Signal-to-Noise Ratio) of the image contrast, the images which are processed by our proposed method have the PSNR values higher than the traditional Retinex algorithm's.

Introduction:
Recent years, haze weather became very serious everywhere. 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 to 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. Images of outdoor scenes often contain degradation due to haze, resulting in contrast reduction and color fading. For many reasons one may need to remove these effects. Unfortunately haze removal is a difficult problem due the inherent ambiguity between the haze and the underlying scene.

All images contain some noise due to sensor error that can be amplified in the haze removal process if ignored. Haze or fog can be a useful depth clue for scene understanding. A bad hazy image can be put to good use. In this dark channel prior is method is used for haze removal.

DEFINATION OF FOG:
The official definition of fog is when visibility is less than 1000m, which is often used with reference to aviation.However, for the general public and motorists, thick fog is considered to be a visibility of 200m or less, with dense fog 50m or less – the point at which severe disruption to transport occurs.

Fig: fog image

How Does The Fog Form?
The mass of air over a particular location has its own characteristics, based on where its origins lie.In autumn, air that arrives across the UK from the south west is warm and holds a lot of moisture.

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For each given mass of air, it will have something called a dew point. This is the temperature at which the air, when cooled, will become saturated.When the air becomes saturated, it is no longer able to hold any more moisture, so the moisture condenses – producing tiny water droplets that become suspended in the air around us. It is this abundance of tiny water droplets suspended in the air that reduces the visibility, forming fog. As you would imagine, the greater the number of water droplets, the lower the visibility and the denser the fog.

Previous Methods:

1. The global image contrast enhancement method
2. Image restoration based on prior information.
3. Automatic image de-weathering using curve let-based vanishing point detection.
4. Single image haze removal using dark channel prior.

PROPOSED METHOD:

Foggy image:

Fogging in photography is the deterioration in the quality of the image caused either by extraneous light or the effects of a processing chemical. In this proposed system an improved fog removing method for the traffic monitoring image, which combining Retinex algorithm and wavelet transform algorithm is proposed. The proposed method firstly use Retinex algorithm to enhance the image, then the wavelet transform algorithm is used to enhance the details of the image, finally a clearly image which are removed fog can be obtained after reduce the none-important coefficients. The proposed method can effectively remove fog from the image taken in heavy fog weather.

BLOCK DIAGRAM OF PROPOSED METHOD:

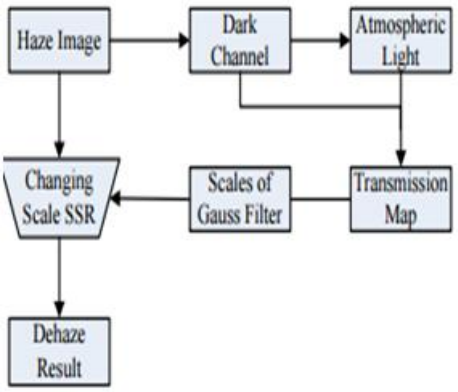

Fig: block diagram

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
- A method bridging the gap between images and the human observation of scenes.
- In order to improve the traffic visibility in haze weathers, a Retinex algorithm based on the changing scale for haze removal with a depth map is proposed. It requires the haze image dark channel prior treatment to obtain the estimated depth map.
- Then it is according to the depth map to calculate Retinex scales for different parts of a hazy image. Finally a single scale Retinex transform is performed for each part of the image.
- The Retinex theory is a kind of model about how the human visual system perceives object brightness and colors.
- The word “Retinex” is the combination of "Retina" and "Cortex". Compared with the traditional image enhancement algorithms, the Retinex can achieve a balance in the dynamic gray range compression, edge enhancement and color constancy.
- The basic idea of the Retinex is that an original image is composed of light image L(x,y) and object reflection properties R(x,y).

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- Depending on the circumstances, Retinex could achieve
- Sharpening
- Compensation for the blurring introduced by image formation process
- Color constancy processing
- Improve consistency of output as illumination changes dynamic range compression.
- MSR could achieve both good dynamic range compression and color rendition for gray pictures.
- Retinex theory deals with compensation for illumination effects in images. The primary goal is to decompose a given image S into two different images, the reflectance image R, and the illumination image L, such that at each point (x,y)in the image domain S(x,y)=R(x,y).L(x,y). The benefits of such a decomposition include the ability to remove illumination effects of back/front lighting, enhance photos that include spatially varying illumination such as images that contain indoor and outdoor zones, and correct the colors in images by removing illumination induced color shifts.
- Retinex algorithm can enhance most of the information of image, however but since it just increases the overall outline, the details of the image are not outstanding. On the other hand, wavelet image enhancement by suppressing low frequency information of the image and enhanced image of high frequency information so as to enhance image details and outline of the image noise reduction at the same time.
- We propose 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 overall outline information of the image.

DISCRETE WAVELET TRANSFORM:

What are wavelets?

Wavelets are functions defined over a finite interval and having an average value of zero.

What is wavelet transform?

The wavelet transform is a tool for carving up functions, operators, or data into components of different frequency, allowing one to study each component separately. The basic idea of the wavelet transform is to represent any arbitrary function $f(t)$ as a superposition of a set of such wavelets or basis functions. These basis functions or baby wavelets are obtained from a single prototype wavelet called the mother wavelet, by dilations or contractions (scaling) and translations (shifts). Discrete wavelet transforms (DWT): DWT is used to decompose an image. DWT is more efficient than DCT transform method. A two level DWT decomposes image into low and high frequency components.

Embedding the watermark in low frequencies obtained by wavelet decomposition increases the robustness with respect to various attacks. Here first media is divided into frames. Then luminance component of each frame is chosen and DWT is applied to it which results into different sub bands. These bands are again divided into different parts. For each part covariance matrix is calculated. By applying inverse DWT watermarked luminance component of the frames are obtained. Finally by reconstructing the watermarked frame watermarked media is obtained. Advantages of DWT over DCT: In Wavelet transform the HVS are more closely processed than the DCT.

Wavelet coded object is a multi-resolution description of object. Hence any media can be shown at different levels of resolution and can be processed sequentially from low resolution to high resolution. The wavelet transform (WT) has gained widespread acceptance in signal processing and image compression. Because of their inherent multi-resolution nature, wavelet-coding schemes are especially suitable for applications where scalability and tolerable degradation are important Recently the JPEG committee has released its new image coding standard, JPEG-2000, which has been based upon DWT.

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- Multimedia Transformations are applied to signals to obtain further information.
- Most of the signals in practice are time-domain signals in their raw format.
- Not always the best representation of the signal.
- The most distinguished information is hidden in the frequency content.

Fourier Transform:

- The frequency spectrum of the signal shows what frequencies exist in the signal
- Frequency domain
- Temporal domain
- No frequency information is available in time-domain
- No time information is available in frequency-domain signal.

INVERSE DISCRETE WAVELET TRANSFORM:

Inverse discrete wavelet transform is used to reconstruct the image.In this process the converted image is combined with the IDWT (Inverse Discrete Wavelet Transform) algorithm and gets an fused image and then al the process were reconstructed. In this process reconstructs the methods and matches with the users input and then recognize.

IMPLEMENTATION:

STEPS OF R+WT METHOD:

(a) Input the fog-image.
(b) Put the above fog-image into logarithm domain.
(c) To obtain the result image R(x,y) by using the above formulation (1) and (2).
(d) By using a linear stretch processing to make the above R(x,y) image size to be similar with the original image.
(e) Using wavelet transform method decomposed R(x,y) image into two layers.
(f) Then to increase the high frequency and suppress low frequency of the image from step(e).
(g) Output the result fog removed image.

Simulation Results:

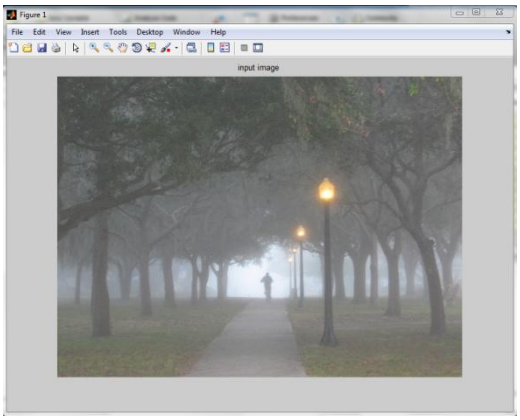

Figure: input fog image

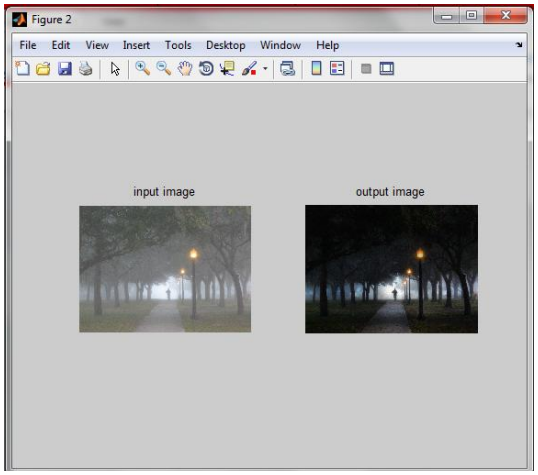

Figure: output of Retinex algorithm

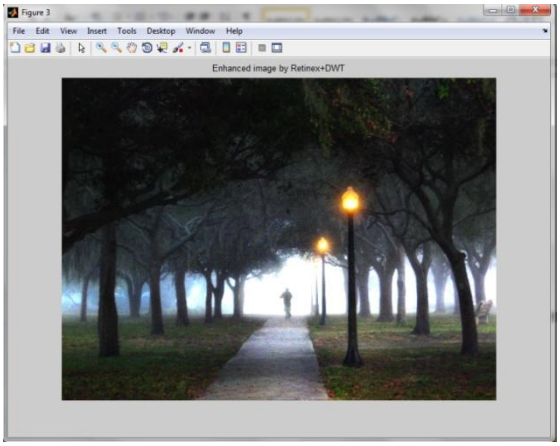

Figure: output of Retinex+DWT

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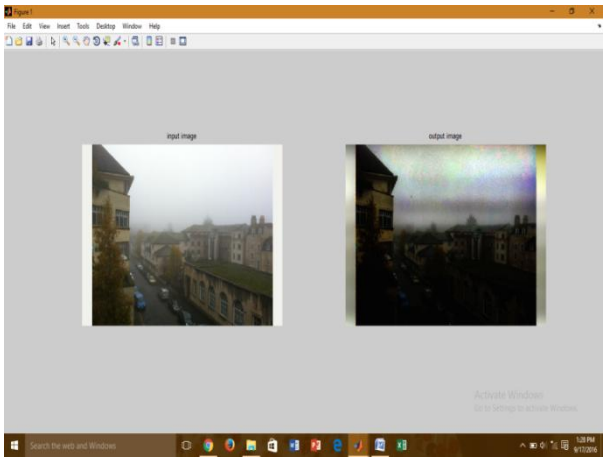

Figure: input and Retinex output images

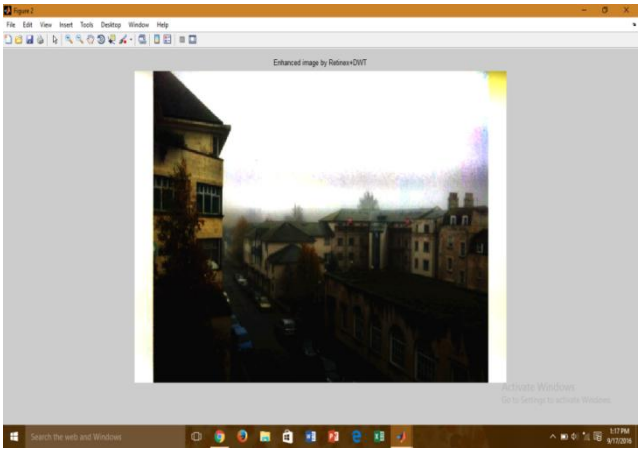

Fig: enhanced by Retinex+DWT algorithm

Conclusion:

We propose 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 overall outline information of the image; then use wavelet image enhancement method to get high frequency information from the Retinex image, finally a more clearly and fog-removed image can be obtained. We evaluated the proposed R+WT method by using two evaluation methods, one is the subjective evaluation, and another is the objective evaluation.

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