International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue14
November 2017

Rain or Snow Removing in a Color Image Using Three Stage Approach Based on Interpolation

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***Abstract**:*

The image restoration is one of the widest technique in image processing, sometimes images are degraded due to rain and snow such situations image components are not perfectly visible . Restoring such images, low pass filters are not preferred because which eliminates some of the object components. To avoid that a new three stage restoration technique for removal of rain and snow is implemented in this project. First of all guided filter for high pass components is implemented from that low pass components are also obtained, by using neighbourhood processing finding the position of rain and snow such that remove the area and finally the unknown components are estimated by using interpolation technique. Further enhancement can be achieved by using the low pass median filter.

***Key words**:*

Restoration, Interpolation, median

1. Introduction

Now a days capturing a good image in a bad weather condition is difficult task, some of those are images which are affected by rain and snow. A rain drop and snow flake affects small portion in image and collection of them which effects heavily,there is some difference between these two images that is rain drops are thin and transparent in nature whereas snowflakes are not transparent in nature, the effect due to rain drop is creates shading it not completely vanish the image components but distortion due to snow vanishes completely the image components. Rain and snow images have some common characteristics of high frequency components, the high frequency components separated from the low pass filter.

The recent work for removing rain and snow in a image is uses the guided filter for separating rain and non-rain components [5] in which the final enhanced image consists still some rain components because of using only simple filtering.Rain streak removal based on decomposition [6] is one of the proposed method it uses morphological component analysis and decompose the image into low frequency and high frequency based on bilateral filter.

Classifying discriminative features for blur detection [9] is proposed for blur removing this method is based on kernel and blur classification theorem and uses pool of kernels for blur classification. Based on the properties of rain and images and previous approaches for restoration of rain and snow images in this paper proposes a method for removing rain and snow in a color image using interpolation

The method proposed for rain and snow in this paper consists of mainly three steps firstly decomposes the low frequency and high frequency components in the image and then finding the positions as well as boundaries of rain pixels, estimate the unknown values of pixels effected by rain and snow by using the interpolation. Finally enhance the resultant image by using median filter.

The rest of the paper is organized as follows section 2 gives general features of rain and snow pixels and effects characteristics of images, section 3 gives proposed method of guided filter for separating the low frequency and high frequency components section 4 describes different interpolation schemes for estimating unknown pixel values section 5 complete flow chart of proposed method section 6describes the results and comparisons finally conclusions.

2. General features of rain and Snow images

The rain and snow in an image has generally some common features consisting of some dynamic components. The rain image has very high intensity values and when compared to neighbouring pixels rain pixels has very high intensity and more transition of pixels in surroundings figure 2.1 shows the rain image in which we can observe the characteristics of rain image. Rain and snow image can be decomposed into high frequency and low frequency components which is very useful in the process of restoration. The difficulty of restoration increase when density of rain and snow is more.

The images which are completely surrounded by snow pixels are not possible to restore because estimating so many unknown components is the detection of rain and snow pixels identified by the high pass filter which

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finds high frequency edges and removes low frequency components, from the high frequency components then position of the rain streak and snowflake identified.

Fig 2.1Rain Image

3. Proposed method

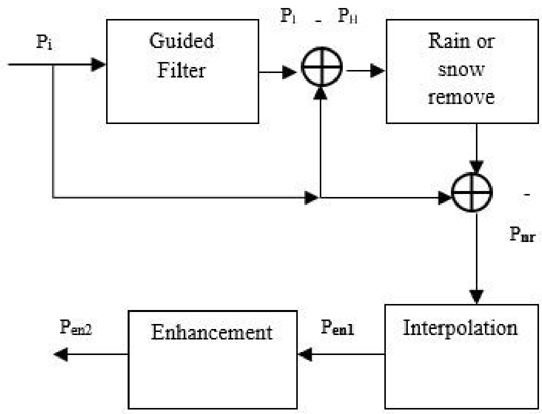

Fig 3.1:Block wise representation of proposed method

The proposed method for rain and snow image is shown in figure 3.1 in that guided filter, rain and snow remove depending on the output of the guided pixel find the position of the rain pixel shown in figure 3.2 ,resultant unfilled pixel positions are estimated by interpolation and finally enhanced using median filter with different sizes if windows

3.1 Guided Filter for detection of Rain and Snow

The guided filter work performs edge-saving smoothing on a picture, utilizing the substance of a moment picture, called a direction picture, to impact the filtering.Guided picture filtering is an area operation, as other filtering operations, however considers the insights of a locale in the comparing spatial neighbourhood in the direction picture while figuring the estimation of the yield pixel.

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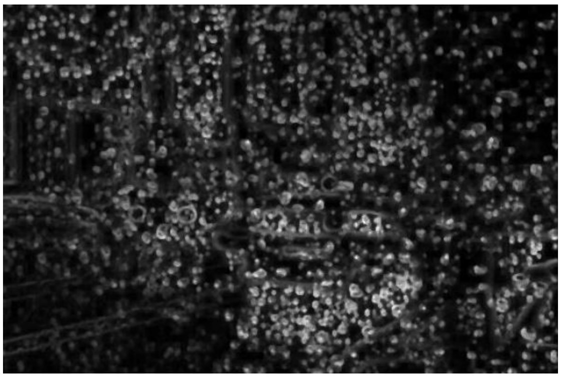


Fig 3.2 positions of the rain pixels

The direction picture can be simply the picture, an alternate variant of the picture, or a totally unique picture on the off chance that the direction is the same as the picture to be filtered, the structures are the same- an edge in unique picture is the same in the direction picture. In the event that the direction picture is unique, structures in the direction picture will affect the filtered picture, as a result, engraving these structures on the first picture. This impact is called structure transference.The detection of rain pixel position after finding the high frequency components as follows

When all is said in done, some low-pass filter that is guided filter can be utilized to disintegrate a rain or snow picture into the low-recurrence part and high-recurrence part.Be that as it may, such a low-pass filtering can scarcely filter out every single dynamic part.To tackle this issue, propose to first play out a rain and snow identification to get the coarse areas of these dynamic segments and afterward apply a guided filter to acquire the low-recurrence part that would turn out to be free of rain or snow totally. Rain and snow location has a place with the classification of protest identification, to which numerous calculations have been produced, including a few exceptionalIn this piece of our work, we wish to keep the location as basic as could reasonably be expected, which can be accomplished by using some natural attributes of rain and snow, as portrayed beneath.

Notice that the rain and snow detection used here is a very strong one and will unavoidably lead to some over-detection mistakes of some times natural image components also removed. Nevertheless, such a detection usually includes all rain streaks for rain images or snowflakes for snow images, especially the rain streaks or snowflakes with high intensities.

4 Image Interpolation

Image interpolation is method of estimating the unknown pixel values based on the values of the neighbouring pixel values. The Image Interpolate operation covers a broad range of interpolation techniques that apply to different types of data. If you are starting from scatter data, i.e., data that is sampled on a non-rectangular grid. Here image interpolation is used to find the unknown rain snow pixel values. The different image interpolation methods are described below

4.1 Nearest neighbour

Nearest neighbour: It is a simplest interpolation. In this method each interpolated output pixel is assigned the value of the nearest sample point in the input image. The interpolation kernel for the nearest neighbour

h(x) = { 0 |x|>0

{1 |x|<0

The frequency response of the nearest neighbor kernel is

H(ω) = sinc (ω/2)

Although this method is very efficient, the quality of image is very poor. It is because the Fourier Transform of a rectangular function is equivalent to a sinc function; with its gain in pass band falls off quickly. Also, it has prominent side lobes are in the logarithmical scale.

4.2 Bilinear interpolation

Bilinear interpolation is used to know values at random position from the weighted average of the four closest pixels to the specified input coordinates, and assigns that value to the output coordinates. The two linear interpolations are performed in one direction and next linear interpolation is performed in the perpendicular direction. The interpolation kernel is given as

u(x) = { 0 |x| > 1

{ 1 – |x| |x| < 1

X is distance between two points to be interpolated

4.3 Bicubic interpolation

The bicubic interpolation is advancement over the cubic interpolation in two dimensional regular grid. It uses polynomials, cubic, or cubic convolution algorithm, and assigns that value to the output coordinates, the first four one-dimension. The bicubic convolution interpolation is given as:

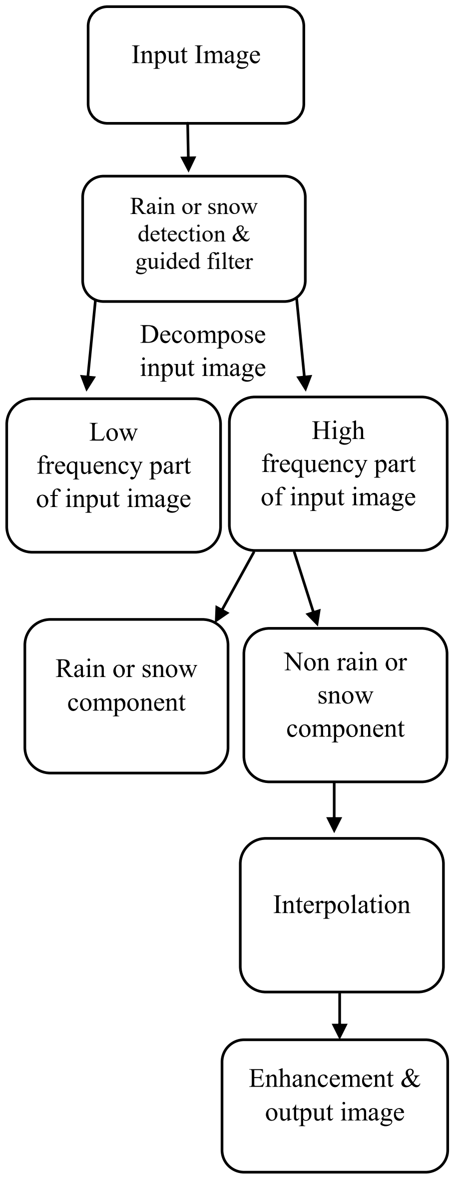
$$w(x) = \begin{cases} (a+2)|x|^3 - (a+3)|x|^2 + 1 & for \quad |x| \le 1 \\ a|x|^2 - 5a|x|^2 + 8a|x| - 4a & for \quad 1 < |x| < 2 \\ 0 & otherwise \end{cases}$$

Where a is generally taken as -0.5 to -0.75

Enhancement

The method of interpolation gives unknown components after that image is processed by a filter for further smoothing two types smoothing techniques are followed those are linear and nonlinear smoothing. Linear smoothing can be done by using

5. Flow Chart



e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue14
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Fig 5.1 Flow chart proposed method

The complete flow chart of the proposed technique shown in fig 5.1, input image first passes through a guided filter by using that obtain the low pass and high pass components, high pass components consists of most of the rain and snow pixels, differentiate rain pixels and non-rain pixel and remove the rain components after that estimate the components of rain pixels using interpolation and filtering finally the output image enhanced by linear low pass filter

6. Simulation Results

The performance of the algorithm is verified by taking different rain and snow images as inputs fig 6.1 shows the snow image of a bird and 6.2 shows the snow removed image using proposed algorithm

Similarly different rain image and corresponding restored images from figure 6.3 to figure 6.10 are shown below

Fig 6.1 snow image1

Fig6.2 Restored image1

Fig 6.3 Rain image2

Fig 6.4 Restored Rain image2

Fig 6.5 Rain image3

Fig 6.6 Restored Rain image3

Fig 6.7 Rain image4

Fig 6.8 Restored Rain image4

Fig 6.9 rain image5

Fig 6.10 Restored Rain image5

Image no:	PSNR	SSIM
Image1	47.15	0.900
Image2	36.01	0.899
Image3	37.94	0.875
Image4	33.75	0.864
Image5	38.25	0.873

Table: 6.1 Performance of proposed method

The performance of proposed method is tested by taking peak signal to ratio and structural similarity index as performance measures, this method gives better PSNR and SSIM for different restored images under rain and snow conditions.

Conclusions

This paper presents a new approach to restore images under bad weather condition of rain and snow. The proposed method in this paper uses guided filter for finding the positions of rain and snow pixels, interpolation method to estimate the unknown components in image and finally median filter for final enhancement of the image. The performance capability of proposed method is verified by taking different images under rain and snow finally proposed method restores the rain and snow images with good visual quality and better PSNR and SSIM.

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