International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072

REMOVAL OF RAIN STREAKS AND SHADOW FROM AN IMAGE

Bhuvana Shree K S[1], Sajitha N[2]

[1]Student, Department of Computer Science and Engineering, BNMIT, Karnataka, India
[2]Assistant Professor, Department of Computer Science and Engineering, BNMIT, Karnataka, India

---***---

Abstract - *Poor quality images degrades the performance of many outdoor vision system like surveillance system, navigation, feature detection, tracking, segmentation, object recognition and so on. This paper addresses the issue of rain streak and shadow removal from an image. Image quality is affected when it is captured during bad weather such as raining, snowfall and so on. Shadow occurs when an object blocks the light to pass through it. The shadow provides useful information about an object. But sometimes it poses problem in various computer vision applications like object detection, segmentation and so on. This paper proposes a methodology to identify and eliminate rain streaks and shadow from an image. Rain streaks are removed from an image by constructing deep network architecture. It is based on deep residual neural network which simplifies the learning process. Shadow is detected based on image's mean value and removed by multiplying shadow region by a constant. Adjustment of shadow edges is performed to decrease the errors because of dispersal in the boundary of shadow.*

***Key Words*: Artifacts, deep residual neural network, guided filtering, illumination, shadow detection, shadow removal**

1. INTRODUCTION

The quality of an image is affected when it is captured during bad weather such as raining, snowfall and so on. This in term degrades the performance of many outdoor vision system which includes surveillance system, navigation, feature detection, tracking, segmentation, object recognition and so on. For an instance, in face detection the rain streaks might occlude the face of human which might result in difficulty to detect face. To address this issue various techniques has been proposed for eliminating rain streaks. Methods falls into two classifications: single image based and video based methods.

A shadow occurs when a non-transparent object occlude light from a light source to travel through it. It is a dark area which occupies in all the three dimensional volume behind an object except with the light present in front of an object. In some instances shadow provides useful information about an acquired scene such as the comparative position from the source of an object. At the same time, they can pose problems for different computer vision algorithms. For instance, the presence of shadow might lead to false detection of an object because the shadow itself may be detected as an object. Hence shadow identification and elimination is used as preprocessing task in various computer vision applications. Shadow is classified as soft and hard shadows based on the intensity. The detection of hard shadows is difficult than the soft shadows. Since soft shadows comprise the surface texture of the background, while the hard shadows are extremely dark and also have a small texture. The hard shadows may be mistaken as dark objects rather than shadows hence it is difficult to detect.

2. RELATED WORK

Garg and Nayar [1] analysed that weather conditions can be mainly grouped into dynamic and steady. Haze, fog and mist comes under steady condition whereas snow and rain are categorized as dynamic condition. Rain droplets are small in steady weather condition and in dynamic weather the particles are 1000 times bigger than in steady weather. Hence, the impacts of dynamic weather such as snow and rain are substantially more unpredictable and have not been concentrated in detail. Chen et al. [2] designed a single color image based rain removal framework to remove rain by decomposing image into high and low frequency based on sparse representation. Framework also improved the visual quality of the degraded image.

Luo et al. [3] designed an algorithm to remove rain visual effects from an image. Because rain drops falling at high velocity is distributed randomly hence visual effects of rain is quite complex. Removal of visual effects of rain from images is also very complex. Sparse coding with high discriminability is used to separate derained and rained image layer accurately. Ding et al. [4] designed guided L0 smoothing filter to eliminate snow or rain from single image. In guided L0 smoothing filter, if the gradient magnitude of guidance image location is large the edges of the noticed image may be reserved and if the gradient magnitude is low they may be smoothed.

Li et al. [5] presented a method which used patch-based priors for the rain and background layers. Method decomposed input image into background layer which is rain free and rain streaks layer. Models like Gaussian mixture are used to construct priors. Fredembach and Finlayson [6] proposed algorithm produces image without shadow quickly and without artifacts. In this method the reintegration is done based on Hamilton path which enters and exists the region of shadow once. Here region of non shadow and shadow is reintegrated individually. Hence, produces shadow free image with less artifacts.

Song et al. [7] algorithm is designed to remove shadow from high resolution images. Algorithm for shadow detection is based on morphological filtering. Example learning method is used for reconstructing shadow. Arbel and Hel-Or [8] proposed an approach to remove shadow from the surface of curves by preserving the information about the texture in the penumbra and provides high quality images without shadow. Scale factor for every pixel is determined and these factors are added to the log domain to remove shadow from the color image.

3. METHODOLOGY

The steps involved in proposed architecture are shown in Figure 1 and Figure 2.

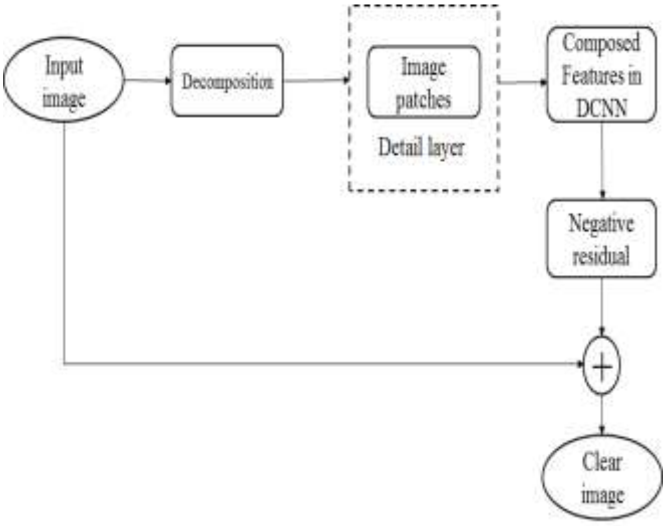

Figure 1: Rain streaks removal system architecture

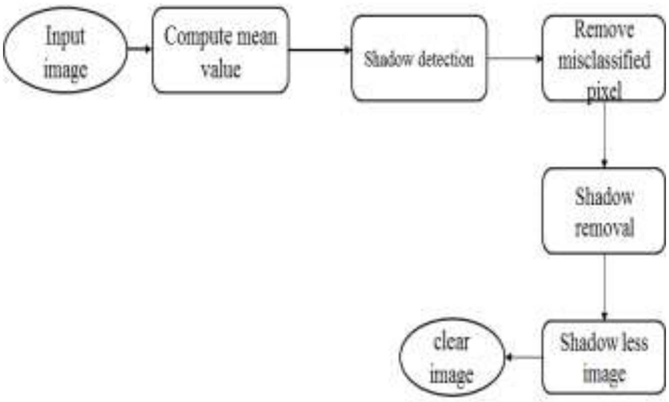

Figure 2: Shadow removal system architecture

The model being proposed identifies and eliminates rain streaks and shadow from an image. In order to remove rain streaks from an image, the input rainy image is decomposed to obtain detail layer [9].

$$I = I_{detail} + I_{base}$$

Where the subscript 'detail' indicates detail layer and the subscript 'base' indicates base layer. Guided filtering [10] is applied on input image *I* to obtain base layer after that detail layer is obtained by subtracting base layer with original image.

$$I_{detail} = I - I_{base}$$

The detail layer contains the structure of rain streaks and object structure which is fed as input into parameter layer. The parameter layer adopts residual neural network for training purpose. Negative residual mapping refers to the difference between clean and rainy image. If the output of residual network structure is blurred it again reconstructed by using input image. Finally, the rain free image is obtained as an output.

The proposed method for removing shadow from a single image comprises of two steps. In first step the shadow detection is done by calculating mean values of pixels separately [11]. Pixels with lower value is classified as pixels of shadow and other pixels as non-shadow. Pixel based method used to detect shadow may misclassify pixels of non shadow as shadow pixels. Dilation and erosion operations are performed in order to eliminate misclassified pixels.

In addition thresholding on area is performed, so that if number of pixels in the region are greater than threshold such regions are considered as shadow. Misclassification of pixels is eliminated by performing these operations. In second step, the shadow is removed by multiplying the constant with the shadow pixels. The illumination of shadow regions is nearly same as the non shadow regions.
But at the shadow edges over-illumination may occur. Median filter is used to overcome over-illumination problem across the shadow edges.

4. RESULTS

Results of proposed rain streaks and shadow removal system is shown in the following figure.

For rain streaks removal system rainy image is given as input and we get rain free image as output shown in Figure 3. Proposed system works well for light rain streaks images. In shadow removal approach shadow image is given as input and shadow free image is obtained as output which is shown in the Figure 4 and Figure 5.

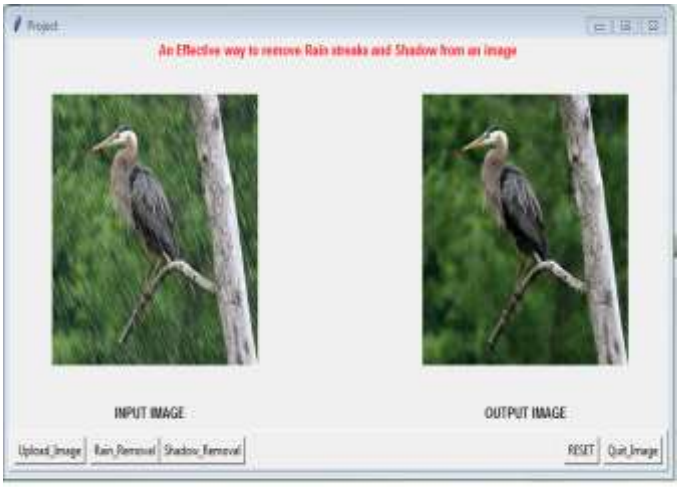

Figure 3: Rain streaks removal method result

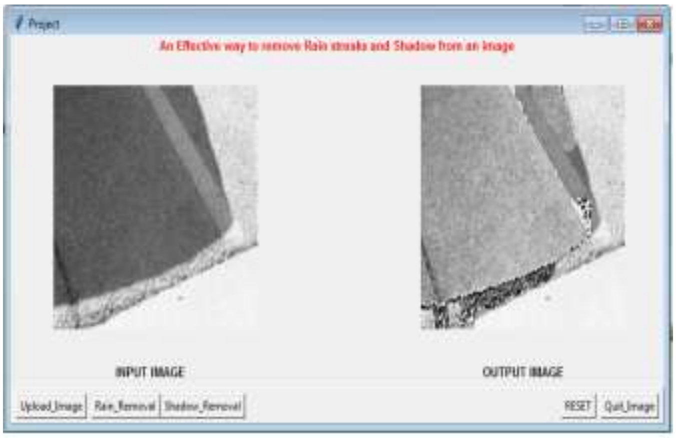

Figure 4: Shadow removal method result for monochrome image

Figure 5: Shadow removal method result for color image

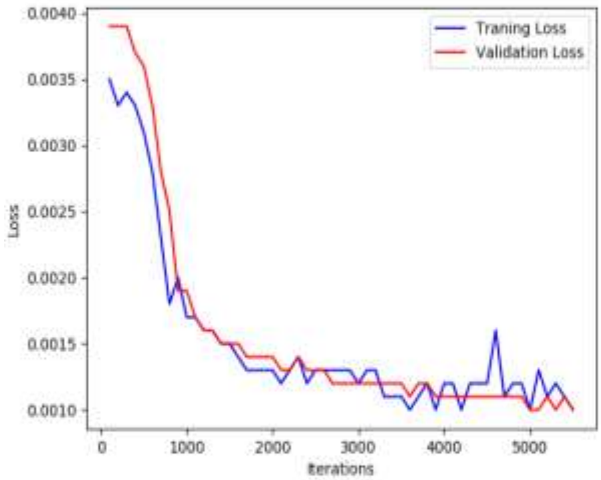

Figure 6: Performance Analysis chart

The red and blue line in the chart shown in Figure 6 refers to validation loss and training loss respectively. The x axis of the graph represents loss and y axis represents iterations.

5. CONCLUSION AND FUTURE SCOPE

This work proposes a method to remove rain streaks and shadow from an image using image processing techniques. Further rain streaks removal can be improved to remove heavy rain streaks from an image and also the rain present in the form of drops needs to be removed. Shadow removal method can be further improved to remove complex shadow from an image.

REFERENCES

[1] K. Garg and S. K. Nayar, "Vision and rain," *Int. J. Comput. Vis.*, vol. 75,no. 1, pp. 3–27, 2007.

[2] D.-Y. Chen, C.-C. Chen, and L.-W. Kang, "Visual depth guided color image rain streaks removal using sparse coding," *IEEE Transactions on Circuits and Systems for Video Technology*, vol. 24, no. 8, pp. 1430–1455, August 2014.

[3] Y. Luo, Y. Xu, and H. Ji, "Removing rain from a single image via discriminative sparse coding.," in *Proceedings IEEE International Conference on Computer Vision (ICCV)*, Boston, MA, USA, pp. 3397–3405, December 2015.

[4] X. H. Ding, L. Q. Chen, X. H. Zheng, Y. Huang, and D. L. Zeng, "Single image rain and snow removal via guided L0 smoothing filter," *Multimedia Tools and Applications*, vol. 75, no. 5, pp. 2697–2712, 2016.

[5] Y. Li, R. T. Tan, X. Guo, J. Lu, and M. S. Brown, "Rain streak removal using layer priors," in *Proceedings IEEE Conference on Computer Vision and Pattern Recognition*

(CVPR), vol. 1. Las Vegas, NV, USA, pp. 2736–2744, July 2016.

[6] C. Fredembach and G. Finlayson, "Hamiltonian path based shadow removal," In *BMVC*, pages 970–980, 2005.

[7] Huihui Song, Bo Huang, Kaihua Zhang, "Shadow Detection and Reconstruction in High Resolution Satellite Images via Morphological Filtering and Example-Based Learning," IEEE Transactions on Geoscience and Remote Sensing, vol.52, no.5, pp.2545,2554, May 2014 .

[8] E. Arbel and H. Hel-Or. Texture-preserving shadow removal in color images containing curved surfaces. In *CVPR*, 2007.

[9] X. Fu, J. Huang, D. Zeng, Y. Huang, X. Ding, and J. Paisley. 2017. Removing rain from single images via a deep detail network. In CVPR. 1715–1723.

[10] K. He, J. Sun, and X. Tang. Guided image filtering. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 35(6):1397–1409, 2013.

[11] Murali, S., V. K. Govindan. Removal of Shadows from a Single Image. – In: Proceedings of 1st International Conference on Futuristic Trends in Computer Science and Engineering, ICCT'12, Vol. 4, 2012, 111-114.