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A Review Paper on Rain Streaks Removal VIA Image Decomposition

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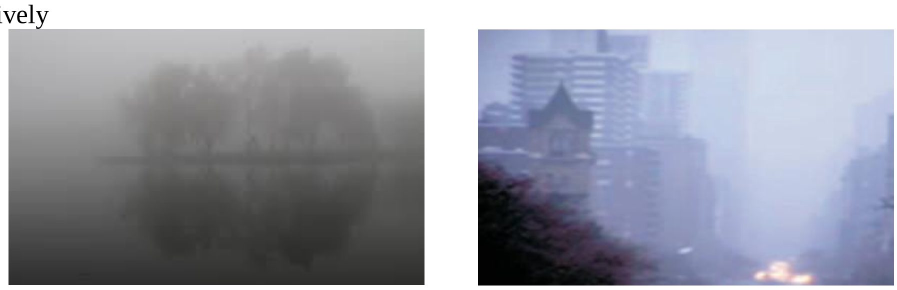
***Abstract**: Weather conditions i.e. rain, snow, fog, mist and haze degrade the quality also performance of outdoor vision system. Rain is one of the type of weather condition as well as rain is the major component for the dynamic bad weather. Rain introduces sharp intensity variations in images, which degrade the quality or performance of outdoor vision systems. These intensity variations depend on various factors, such as the brightness of the scene, the properties of rain, and the camera parameters. Rain removal has many applications in the field of security surveillance, vision based navigation, video or movie editing and video indexing or retrieval. So, it is important to remove rain streaks from the images.in this paper we have discuss previously proposed methods for rain streaks removal from the video.*

Keywords: Image decomposition, Morphological component analysis, Sparse coding, dictionary learning

I. INTRODUCTION

Rain removal from a video is a challenging problem and has been recently investigated extensively. Nevertheless, the problem of rain removal from a single image was rarely studied in the literature. different weather conditions such as rain, snow, haze, or fog will cause complex visual effects of spatial or temporal domains in images or videos . Such effects may significantly degrade the performances of outdoor vision systems relying on image/video feature extraction or visual attention modeling , such as image registration , event detection , object detection , tracking, and recognition, scene analysis and classification, image indexing and retrieval , and image copy/near-duplicate detection. There are two types of bad weather conditions: steady and dynamic [1]. Figure 1 and 2 show the steady and dynamic weather conditions respectively



(a) Mist (b) fog

Figure1 The visual appearance of steady weather conditions

(c) rain (d) snow

Figure2 The visual appearance of dynamic weather conditions

A comprehensive survey of detection approaches for outdoor environmental factors such as rain and snow to enhance the accuracy of video-based automatic incident detection systems can be found . Removal of rain streaks has recently received much attention.in this paper we have disscuss the brief review on different methods used for rain streaks removal, such as by using temporal and chromatic properties, using correlation model, using histrogram of orientation of streaks and finally using image decomposition. In the following subsection ,we first briefly review on rain detection and removal method.

II. RELATED WORKS

A. By using correlation model and motion blur model

The visual effects of rain are complex. Rain consists of spatially distributed drops falling at high velocities. Each drop refracts and reflects the environment, producing sharp intensity changes in an image. A group of such falling drops creates a complex time varying signal in images and videos. In addition, due to the finite exposure time of the camera, intensities due to rain are motion blurred and hence depend on the background intensities. Thus, the visual manifestations of rain are a combination of both the dynamics of rain and the photometry of the environment. In this method the first comprehensive analysis of the visual effects of rain on an imaging system. here developed a correlation model that captures the dynamics of rain and a physics-based motion blur model that explains the photometry of rain. Based on these models,and develop efficient algorithms for detecting and removing rain from videos. The effectiveness of this algorithms is demonstrated using experiments on videos of complex scenes with moving objects and time-varying textures. The described technique can be used in a wide range of applications including video surveillance, vision based navigation, video/movie editing and video indexing/retrieval.

Note that simple temporal filtering methods are not effective in removing rain since they are spatially invariant and hence degrade the quality of the image in regions without rain. In contrast, this method explicitly detects pixels effected by rain and removes the contribution of rain only from those pixels, preserving the temporal frequencies due to object and camera motions. The proposed algorithm can be used in a wide range of applications including video surveillance, video/movie editing, and video indexing/retrieval. this models also have implications for efficient and realistic rendering of rain. Currently, we do not handle the steady effects of rain and we do not remove severely defocused rain streaks. In future work, address these issues and also extend our analysis to other types of dynamic weather conditions such as snow and hail.

B .Using Combining temporal and chromatic properties:

Removal of rain streaks in video is a challenging problem due to the random spatial distribution and fast motion of rain. Zhou proposed a method for rain removal in sequential images. They have used spatial temporal property and the chromatic property. As per the spatial-temporal property, rain is detected by using improved k-means. Then a new chromatic constraint is advanced to mend detection results. They have considered the image in which rain is close to the camera. Rain in image is removed, but new image means non-rain image is a little blurry. This paper presents a new rain removal algorithm that incorporates both temporal and chromatic properties of rain in video. The temporal property states that an image pixel is never always covered by rain throughout the entire video. The chromatic property states that the changes of R, G, and B values of rain affected pixels are approximately the same. By using both properties, the algorithm can detect and remove rain streaks in both stationary and dynamic scenes taken by stationary cameras. To handle videos taken by moving cameras, the video can be stabilized for rain removal, and destabilized to restore camera motion after rain removal. It can handle both light rain and heavy rain conditions. Experimental results show that the algorithm performs better than existing algorithms.

C .using histrogram of orientation of streaks:

The detection of bad weather conditions is crucial for meteorological centers, specially with demand for air, sea and ground traffic management. In this article, a system based on computer vision is presented which detects the presence of rain or snow. Bossu proposed a method in which detection of rain is done using histogram of orientation of streaks. In this the orientations of the different connected components are obtained by the method of geometric moments. The data of this histogram are then modeled as a Gaussian-uniform mixture. A decision criterion on the smoothed histogram then allows detecting the presence or absence of rain. When rain is detected, the rain pixels can be detected accurately and easily in the images and rain intensity can be estimated as well.

To separate the foreground from the background in image sequences, a classical Gaussian Mixture Model is used. The foreground model serves to detect rain and snow, since these are dynamic weather phenomena. Selection rules based on photometry and size are proposed in order to select the potential rain streaks. Then a Histogram of Orientations of rain or snow Streaks (HOS), estimated with the method of geometric moments, is computed, which is assumed to follow a model of Gaussian uniform mixture. The Gaussian distribution represents the orientation of the rain or the snow whereas the uniform distribution represents the orientation of the noise. An algorithm of expectation maximization is used to separate these two distributions. Following a goodness-of-fit test, the Gaussian distribution is temporally smoothed and its amplitude allows deciding the presence of rain or snow. When the presence of rain or of snow is detected, the HOS makes it possible to detect the pixels of rain or of snow in the foreground images, and to estimate the intensity of the precipitation of rain or of snow. The applications of the method are numerous and include the detection of critical weather conditions, the observation of weather, the reliability improvement of video-surveillance systems and rain rendering.

The disadvantage is that rain with small intensity is difficult to be seen for human eyes, and thus to be detected with the proposed method. In the presence of light rain, the Mixture of Gaussian is no longer relevant. However, in the absence of rain, this method may also detect rain presence. The proposed which consists in detecting rain by using video cameras. To ease the integration of the algorithm in video-surveillance systems, we use a classical MoG model to separate the foreground from the background in image sequences. Because rain is a dynamic weather phenomenon, the foreground is used to detect it. From the foreground model, selection rules based on photometry and size are used in order to select the potential blobs of rain. Then we compute a Histogram of Orientations of Streaks (HOS) with the method of geometric moments. The HOS is assumed to follow a Gaussian-uniform mixture model, where the Gaussian distribution represents the orientation of the rain and the uniform distribution represents the orientations of the noise. use an EM algorithm to separate these two distributions as well as a GoF test coupled with a Kalman filter and a test on the surface of the Gaussian distribution to deduce the information on rain presence. When rain presence is detected, we proceed with detecting the pixels of rain in the foreground model or with estimating the rain intensity.

The applications of the method are numerous, among them the video-surveillance of road networks, the improvement of the reliability of video surveillance systems are shown and rain rendering. Various methods have been proposed to remove rain in images. Even if these methods and the method proposed in this article do not have the same objective, they share common ideas and principles. We have compared the different methods qualitatively and quantitatively. In particular, we have shown how they complement each other. Numerous experiments have been carried out to rate the proposed method, which rely on the use of synthetic images as well as actual video sequences grabbed by ourselves in different weather conditions such as clear weather, hail, rain, snow and storm. Finally, we have proposed different perspectives for future work.

D. using Probabilistic Model

K. Tripathi and S. Mukhopadhyay [3] proposed a efficient, simple, and probabilistic model based rain removal algorithm.This algorithm is better to the rain intensity variations. Probabilistic approach automatically adjust the threshold and effectively differentiate the rain pixels and non-rain moving object pixels. Differentiation is done between the rain and non-rain moving objects by using the time evolution of pixels in consecutive frames. This algorithm does not assume the shape, size and velocity of the raindrops and intensity of rain, which makes it robust to different rain conditions. Advantage of this algorithm is that it automates the algorithm and reduces the user intervention. Here, it is assumed that the video capturing camera is static. There is a significant difference in time evolution between the rain and non-rain pixels in videos. This difference is analysed with the help of the skewness and Pitman test for symmetry. Quantitative results show that proposed algorithm gives lower number of miss and false detection in comparison with other algorithms. This algorithm helps to reduce the complexity and execution time of the algorithm because it works only on the intensity plane. This method is more robust dealing with dynamic scenes, however some statistical feature it proposes works poorly in many occasions, and it gives a lot of false detections.

E. using Motion Segmentation

Jie Chen and Lap-Pui Chau [5] used a novel approach for rain removal. These algorithm is based on motion segmentation of dynamic scene. The pixel intensity variation of a rainy scene is caused by rain and object motion. The variation caused by rain need to be removed, and the ones caused by object motion need to keep it as it is. Thus motion field segmentation naturally becomes a fundamental procedure of these algorithm. Proper threshold value is set to detect the intensity variation caused by rain. After applying photometric and chromatic constraints for rain detection, rain removal filters are applied on pixels such that their dynamic property as well as motion occlusion clue are considered; both spatial and temporal information are then adaptively use during rain pixel recovery. These algorithm gives better performance over others for rain removal in highly dynamic scenes with heavier rainfall. Fig.3 shows the block diagram of rain removal pixel using motion segmentation.

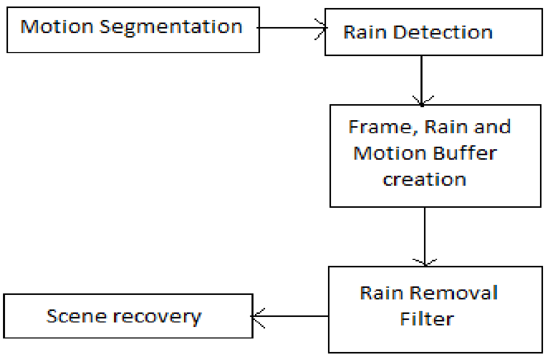


Fig. 3 Block Diagram of rain removal pixel using motion segmentation

F. using Spatiotemporal Properties

A. Tripathi and S. Mukhopadhyay [4] used a spatiotemporal properties for detection and removal of rain from video. The spatiotemporal properties are involved to separate rain pixels from non-rain pixels. It is thus possible to involve less number of consecutive frames, reducing the buffer size and delay. It works only on the intensity plane which further reduces the complexity and execution time significantly. This algorithm does not assume the shape, size and velocity of raindrops which makes it robust to different rain conditions. This method reduces the buffer size, which reduces the system cost, delay and power consumption. This method gives out false result for dynamic scenes.

G. rain streaks removal via image decomposition.

Rain removal from a video is a challenging problem and has been recently investigated extensively. Nevertheless, the problem of rain removal from a single image was rarely studied in the literature, where no temporal information among successive images can be exploited, making the problem very challenging. In this paper, propose a single-image-based rain removal framework via properly formulating rain removal as an image decomposition problem based on morphological component analysis. Instead of directly applying a conventional image decomposition technique, the proposed method first decomposes an image into the low- and high frequency (HF) parts using a bilateral filter. The HF part is then decomposed into a "rain component" and a "nonrain component" by performing dictionary learning and sparse coding. As a result, the rain component can be successfully removed from the image while preserving most original image details.

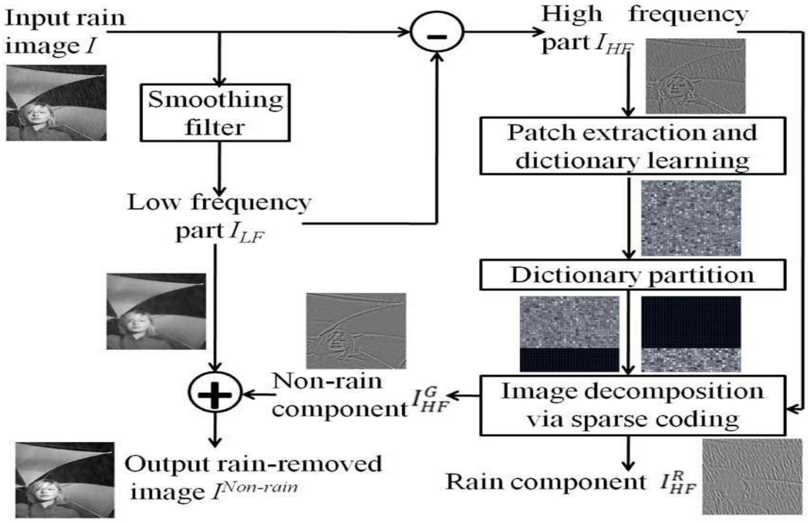


Fig. 4 Block diagram of the proposed rain streak removal method

The dictionary learning of the proposed method is fully automatic and self-contained where no extra training samples are required in the dictionary learning stage. also provided an optional scheme to further enhance the performance of rain removal by introducing an extended dictionary of nonrain atoms learned from nonrain training images. experimental results show that the proposed method achieves comparable performance with state-of-the-art video-based rain removal algorithms without the need of using temporal or motion information"" for rain streak detection and filtering among successive frames.

For future work, the performance of our method may be further improved in terms of computational complexity and visual quality by enhancing the sparse coding, dictionary learning, and dictionary partitioning processes. More specifically, since the dictionary learning and sparse coding consume most of execution time, the input image can be segmented into several local regions with different local characteristics such that the online dictionary learning for individual regions can be performed in parallel to accelerate the two processes by taking advantage of current multicore processor technology.

IV. CONCLUSION

This paper presents an extensive survey on rain removal techniques for video. Currently, many new schemes are proposed in the field of video compression. Rain removal via image decomposition is widely used technique and it gives better result for highly dynamic scene.

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