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AN IMPROVED RAIN PIXEL RECOVERY ALGORITHM FOR DYNAMIC SCENES

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ABSTRACT

Security surveillance and movie editing are such an applications in which rain removal is an important and also very useful technique. By considering certain properties like photometric, chromatic and probabilistic properties of the rain several rain removal algorithms were proposed to detect and remove the rainy effect. The existing algorithm work well with light rain and static scenes while dealing with heavy rain and dynamic scenes, these algorithm have poor visual results. The proposed algorithm is based on motion segmentation & rain detection for dynamic scene, in this algorithm 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 exploited during rain pixel recovery. The result shows that the proposed algorithm has better performance than the current algorithms for rainy scene having large motion. The proposed paper is one of the beneficial purpose tools for movie editing or other investigation software or security surveillance. In proposed project there is use of some effective algorithms used by which the rainfall can be removed for both static as well as dynamic scenes in video.

The Objective of the project is to remove rain pixels in the videos without losing the information. The existing method is based on motion segmentation.

Key words—Motion segmentation, motion occlusion, dynamic scene, motion buffering, adaptive filters, rain removal.

I.INTRODUCTION

Rain removal is a very tedious task. In some of videos there occurs fluctuations in the videos, these fluctuations are caused due to dynamic objects or the camera motion, object motion, etc, due to this fluctuations the pixel intensity gets changed through its original values also due to rain there is fluctuations in the pixels to remove this rain and the fluctuation. There are many methods proposed in that the main need was to detect the rain and replace it by its original value of the pixels. First the analysis was done by Garg and Nayar in account to photometric [1][2] and the physical properties. They detect the intensity and temporary constraints by their observations but they could work for the uniform velocities and directions of the rain drop were limited. Zhang proposed further methods in which the chromatic properties [3] where took into considerations .In this the R,G,B intensity changes for those objects which are in motion. This algorithm worked only for static scenes and also for only certain color backgrounds. Tripathi proposed probabilistic spatial-temporal model where they detect fluctuations and the intensity range this model was applicable for both static and the dynamic background but this method did not work for the heavy rain and speedily moving objects. The short coming of the existing methods is the prediction of rain covered pixel's original value and also the rain detection. Due to this the areas having motion is affected and important information are erased a ghost effect is observed. The proposed algorithm is based on motion segmentation of dynamic scene. After applying photometric and chromatic constraints for rain removal filter, rain detection 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 exploited during rain pixel recovery. Experiment results show that our algorithm outperforms existing ones in highly dynamic scenarios**.**

II. RELATED WORK

Garg and Nayar first carefully studied the physical and photometric properties of the rain, and they used their instances such as watching, noticing, or making a statement data to apply both strength and time-related restrictions to detect and then remove the rain. However, their ideas such as the uniform speeds and directions of the rain drops limited its performance. Zhang proposed a method based on chromatic restriction, where they assume that strength changes in the R, G, B channels caused by rain are about the same, while those caused by object motion are the left side different from the right side. This method is only related with static background, and it gives out faulty results for particular foreground colors. Tripathi et al. proposed a probabilistic spatial-temporal model, in which they propose to use statistical features, such as intensity fluctuation range, and spread asymmetry, which are extracted from a spatial-temporal neighborhood to classify the rain affected pixels. This method is more robust when dealing with dynamic scenes, however some statistical features it proposes (i.e. spread asymmetry) works very poorly in many occasions, and it gives a lot of false detections. Except from rain detection, one shared drawback of the existing methods is that, in the prediction of the rain covered pixel's original value, where they simply compute its temporal mean. This causes serious corruptions in areas where obvious motion is present; important information are erased; and a totally undesired ghost effect is often seen. The proposed algorithm is based on motion segmentation of dynamic scene. 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 is considered; both spatial and temporal information are then adaptively exploited during rain pixel recovery. Experimental results and simulations show that our algorithm outperforms existing ones in highly dynamic scenarios.

The following are the steps to be followed to remove the rain from video.

III.MOTION SEGMENTATION

By using the method of object motion retainment the rain and object motion can be removed which are caused due to pixel fluctuation of rainy scene. The motion segmentation is divided in certain parts like:

- Estimation of motion field
- Including local properties
- Combination of motion and locality cues

Motion field are 2-D vector which are projected from 3-D vector of a dynamic scene. The moving object could be recognized using the motion segmentation. The moving object is evaluated with the help of optical flow. For constraint of intensity conversation the chain rule for differentiation is applied. To predict the relative displacement between adjacent frames of objects optical flow gives the accurate output. The local properties like pixel location and chromatic values into the segmentation the pixel's colour information are formed.

IV.RAIN DETECTION

Rain detection contains three main types:

A) Differencing and Thresholding

B) Applying photometric & chromatic constraints

C) Motion exclusion

The difference between two frames is calculated and threshold by using grey scale intensity. The intensity fluctuations which are caused due to rain can be detected by setting the threshold value given by (1).

$$I_{diff} = \begin{cases} 1 & IN - IN - 1 \geq D\ th \\ 0 & IN - IN - 1 < D\ th \end{cases} \longrightarrow \quad (1)$$

Firstly photometric constraints are calculated by applying the conditions. The constraints of intensity fluctuation are applied on the pixels, by considering the speed of rain and the camera motion also the dimension of the camera in which it is moved. After applying the photometric and the chromatic constraint if the pixels fail in the differencing then constraints are removed from the rain steak. The objects which are in motion and the objects covered by rain are treated separately, and they are divided into two frames and these frames are considered differently which is given as (2).

I_Rain = I_Diff – I_Fail $\longrightarrow$ (2)

Quantitative comparison between different methods [4], [5] are carried out for rain detection [8] over static scene background. The video used is car (frame size 340 × 520), the rain is rendered using methods proposed in [8], and the rain ground truth is calculated as difference between the two videos before and after rain rendering [9]. The measuring metric is the rain mis-detection rate (MD/pels) [5], and false detection rate (FD/pels) [6].One can see that the proposed hybrid method produces lower total error as compared to other competing methods [4], [7].

Rain pixels within the motion object and the background must be treated separately, hence here IRain is divided into two sets namely: 1. rain candidate pixels in the motion target area will comprise the set Sm; 2. Rain candidate pixels in the background area will comprise the subset S_b. Finally, the pixels that are not included in S_m or S_b form the set S_p, which are the pixels that are not covered by rain. The definition of S_m, S_b and S_p are expressed in the equations (3), (4), (5). S_c is the complete set of frame pixels [5], BM is the motion buffer [9].

$$S_m = \{I(x,y) | I_{Rain}(x,y) = 1 \& B_M(x,y,n) = 1 \longrightarrow (3)$$

$$S_b = \{I(x,y) | I_{Rain}(x,y) = 1 \& B_M(x,y,n) = 0 \longrightarrow (4)$$

$$S_p = S_c - S_m - S_b \longrightarrow (5)$$

V.FRAME,RAIN AND MOTION BUFFER

The three buffers are created for rain removal:

- Video frames buffer
- Rain buffer
- Motion buffer

In these three buffer each buffer is having three parameter like length, width, Depth of buffer. Each layer of video frame buffer has one video frame and new frame is pushed on top of buffer and oldest frame is moved out from bottom. The rain buffer records binary rain map for corresponding video frame in Video buffer and motion buffer records the corresponding binary motion.

VI.SCENE RECOVERY

This algorithm works on central frame ,as both past and future information In video, rain and motion buffer could be retrieved for better scene recover performance.

- Rain covered pixels in "static" scene Background
- Rain covered pixel in motion object
- Pixel uncovered by rain

The filter coefficients are set, which makes the filter shaped as Gaussian with variance along time axis but no special neighbour values are used, those are temporally assigned with highest weights, according to when a certain pixel is covered by rain, camera motion or background lighting pixels are close to the original values. For pixel which are not covered by rain their values are simply kept unchanged. The fact that pixel values changed fast when it belongs to motion object and it also has 2-Dgaussian shaped distribution which is further calculated.

VII.EXPERIMENTAL RESULTS

In the proposed experiments, the camera used is Sony camera to take some videos with various raining scenes, including light, moderate and heavy rain in static and dynamic situations. Moreover, for comparison with the method , it is also tested our algorithm on the movie clips presented. The following figure shows rain removal in static scene. Almost all the rain streaks are removed perfectly. The enlarged views show that both rain streaks in-focus and out-of-focus are removed completely. Figures 1-6 illustrates the detection and removal results of two frames in dynamic scenes. The results show that our algo-rithm can effectively distinguish rain drops and moving human body. Furthermore, comparison with the results of Garg and Nayar shows that our method detects the background colors more accurately and gives a rain removed video with better visual quality.

Fig. 1: Input image

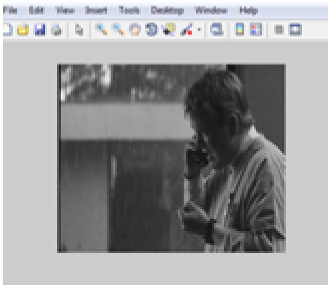

Fig.2: Grayscale image

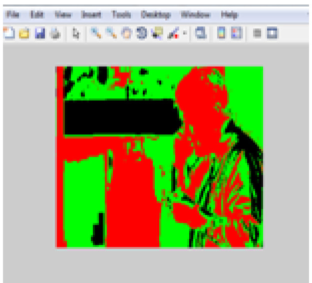

Fig.3: Segmentation image

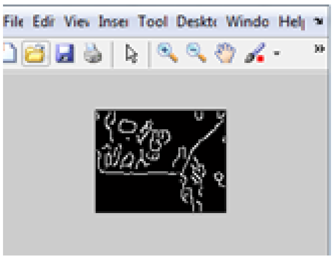

Fig.4: Rain Detection

Fig. 5: Rain Removal Image

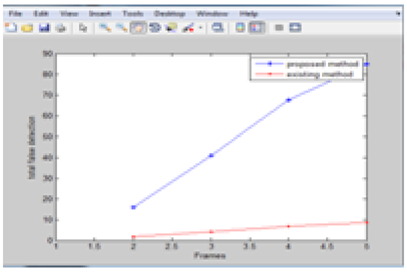

Fig. 6: Average performance of frames and Total detection

VIII.COMPARISON OF EXISTING METHOD WITH PROPOSED METHOD IN TABLE I

Algorithms	MD|pels	FD|pels	Total error|pels
1. Garg and Nayar	274	1987	2261
2. Zhang	247	2236	2483
3. Tripathi et al.	63	1822	1885
4.Existing	686	786	1472
5.Proposed system	655.26	582.06	1237.32

IX.CONCLUSION

Existing rain removal algorithms perform poorly in extremely dynamic scenes, serious component corruptions typically occur in motion intensive areas, that is caused by ignoring motion occlusions throughout component recovery. Supported the planned motion segmentation theme, in this paper the method that recovers the rain components specified every pixel's dynamic property additionally as motion occlusion clue is considered; each spatial and temporal info area unit adaptively exploited throughout rain pixel recovery. The proposed motion segmentation results outperform the photometric and chromatic results by 15.9% in extremely dynamic eventualities.

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