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# A Review on Frame Indexing and Labeling in Dynamic Rainy Video Scenes with Rain Pixel Recovery

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***Abstract***— Rain act as a noise that affect videos and images. Mostly, noises are observed due to weather conditions that will affect audio correspondence, object recognition, motion segmentation, and object tracking. While editing movie or any security surveillance if any problem is found due to rain constraints the object cannot be tracked well. Rain drops are spatially distributed which falls at very high velocities. Hence, it leads to produce sharp intensity variations in an image where each drop refracts and reflects the environment. Such group of falling rain drops generates a complex time varying signal in both images as well as in videos. Random rain pixel detection and noise filtrations lead to achieve the high performance in dynamic videos having various vision-based applications. So, by extracting the key frames from the large size video we can compress it to smaller one which helps to retrieve dynamic frame through indexing and labeling. After the key frame selection rain pixel recovery algorithm will provide the compressed video with the rain pixel recovery from highly dynamic scenes.

Keywords— Rain Detection, Properties, Background Subtraction, Spatial-Temporal, Rain Removal, Static Weather Condition, Dynamic Weather Condition, Frame Indexing and Labeling

## I. Introduction

Visualizing moving objects having a video sequence is a fundamental and complex task in video surveillance, object detection with tracking, traffic monitoring and analysis, and gesture recognition [1]. In rainy videos, the appearance of large intensity fluctuation could be caused due to many reasons besides rain fall such as object motion, weather conditions, and camera movement. A very useful approach to identifying the moving objects is to subtract background, where each video frame is compared against a referenced frame or background scene. The artificial appearance is formed in indoor environment whereas bad effects due to weather conditions appeared on outdoor environment. Various algorithms have been proposed with the outdoor system for feature extraction, object detection, segmentation etc. After the complete analysis of weather conditions with their physical properties two kinds of conditions are detected: static and dynamic [2].

Following figure 1 and 2 shows the static and dynamic weather conditions respectively. Fog, mist and haze behave as a static weather conditions with the particle size of about 1-10 µm. Rain, snow and hail behave as a dynamic weather conditions with the particle size 1000 times larger than the static conditions. Due to large droplets size in dynamic weather conditions objects get blurred motion. That kind of noise degrades the performance of vision based system with the feature extraction, segmentation, motion identification. Also, the object recognition becomes very difficult. The major property of rainy scene is that the image pixel never covered by rain over the complete video. Hence, for the purpose of restoration whole concentration is giving towards the investigation of dynamic weather conditions.

Fig 1: Fog

Fig 2: Rain

The major component of dynamic video is rain. Rain drops are transparent and also act as a spherical lens [2]. It strongly depends on brightness of background. Reflection and refraction makes the rain drops very brighter than background when the light passes through it. The motion gets blurred when it falls at high velocity in any random direction. Removal of rain drops and snow particles is very difficult because the rain streak has an effect of integration time of camera, the brightness of the drop and background scene radiances. In order to remove the rainy effect, it is essential to detect the intensity fluctuations that are caused by rain, and then replace them with their original pixel value.

## II. LITERATURE REVIEW

Garg and Nayar accurately detected rain in videos [2]. While observing, they faced certain problems that when rain is much heavier or lighter or when much farther from the lens, rains cannot be detected or removed. After a comprehensive analysis about the relationship between rain's visual effect and camera parameters like depth of field, exposure time, etc are made. According to analysis result they concluded that the camera parameters can remove the rain without blurring its background and the parameters are cannot always changed. So, this method cannot successfully work with the heavy rain conditions.

Garg and Nayar [3] proposed another method in which assumptions are made on photometric model. The physical properties of rain help to visualize the concept of photometric model. A comprehensive analysis is made on the visual effect of rain and the dynamic factors that affecting it. According to their observations they assumed that the affecting raindrops shows its impact only on single frame and also a very few raindrops affect two consecutive frames. Because of that intensity varies which is equal to the intensity difference between the pixel in the current frame and in the consecutive frame when raindrop covers a pixel. It gives a lot of false detections. To avoid false detected pixels, further assumptions are made on linear photometric constraints of raindrops. Heavy raindrops affect the same position in two or three consecutive frames. Almost raindrops have similar size and velocity that was assumed in the photometric model. But, after observation it seems that the size and velocity of raindrops got to be varied which lead to violate the assumptions of the photometric model.

Zhang [4] proposed a method which is based on both temporal and chromatic constraints of the rain. The temporal property shows that the same pixel may not contain rain over the entire video because of random distribution of rain. It is assumed that variations in RGB color components due to raindrops are same while considering the chromatic constraints. A threshold value is provided to bound the variations. A limitation for chromatic constraints is that it will not identify rain streaks in a slight motion and gray regions. Zhang assumed that the camera is static but for dynamic camera they have suggested video stabilization before removing rain and destabilization after removing rain. But, that will be a difficult method.

Barnum [5] proposed a method in frequency space. Here, first analysis is made on individual rain streak and snow. Then this model fit to a video and used to detect rain or snow streak in frequency space. After that detected result is transferred to image space. This method is not applicable for the light rain because the pattern formed in frequency space is not distinct. Hence, it becomes a major drawback for this method.

Zhou [6] proposed a method for rain removal in sequential images with the use of spatial temporal property and the chromatic property. Here, rain is detected using k-means method. After that a new chromatic constraint is advanced to detect the results. Zhou assumed the image or video in which rain is close to camera. The rain is removed from the video but some new images remains blurry.

Bossu [10] proposed a method in which is based on detection of rain using histogram model. Here, histogram rain streaks are oriented. Geometric moment methods are used to connect orientation of different components. This histogram data are used to model Gaussian-uniform mixture model. It helps us to detect the presence or absence of rain. If rain is detected, rain as well as its intensity can be easily estimated. Rain's small intensity is difficult to be seen for human eyes. This method helps to detect it. But, in the presence of light rain the Mixture of Gaussian is no longer relevant. It may detect presence of rain in the absence of rain also.

Table 1: Summery of previously existing approaches

| Sr. No. | Author name | Methodology Used | Drawbacks |
|---|---|---|---|
| 1. | Garg and Nayar[2] | To detect rain in videos and concluded that by adjusting the camera parameters rain can be removed without blurring the background. | In heavy rain condition this cannot be done and parameters cannot always be changed. |
| 2. | Garg and Nayar[3] | Analyzed the physical and photometric properties. | The uniform velocities and directions of the rain drops limited its performance. And this gives lot of false detections. |
| 3. | Zhang[4] | Proposed method is based on both temporal and chromatic constraints. | This method is only applicable with static background, and it gives out false result for particular foreground colors. Identification of rain streaks was very difficult. |
| 4. | Barnum[5] | Proposed a method in frequency space. | It is not applicable for light rain, since the pattern formed in frequency space is not distinct. |
| 5. | Zhou [6] | Proposed a method for rain removal in sequential images with the use of spatial temporal property and the chromatic | Rain in video is removed, although new image is a little blurry. |

  

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|---|---|---|---|
| | | property. | |
| 6. | Bossu [10] | Proposed a method in which detection of rain is done using histogram of orientation of streaks. | In the absence of rain, this method may also detect rain presence. |

## III. CONCLUSIONS

There are various techniques have been proposed in the field of rain detection and rain removal. Many open issues are described by the researchers such as dealing with heavier rainfall in dynamic scenes. Also, many research issues have been highlighted and directions for future work have been suggested which will helps to avoid drawbacks of previously existing methods. Various proposed algorithms address the issue of detecting rain only in the presence of static scenes, thus require dozens of successive frames to extract the key frame for dynamic scenes. It helps to retrieve the content of the video easily. This paper presents an extensive survey on rain pixel recovery techniques for both static and dynamic scenes. Hence, to get efficiency over dynamic scenes frame indexing and labeling technique with rain pixel recovery algorithm will be used. Flexible video segmentation with dynamic scenes can be possible with the use of rain pixel removal algorithm.

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