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Survey on Denoising and Enhancement of Extremely Low-light Video

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Abstract *– The two major characteristics of an extremely low-light video is the Dynamic Range (DR) and Signal to Noise Ratio (SNR). Here, improvement and noise suppression of an especially low-light video is planned. In this paper we tend to studied a completely unique approach for noise reduction and improvement of very low-light video. In this paper different research papers are studied related to the Denoising and Enhancement of Extremely Low-light Video.*

Keywords*: Noise reduction, tone mapping, nonlocal means, and low-light video,*

I. Introduction

For video process, we consider the High Dynamic range (HDR) videos for the aim of getting higher results. Over the last several decades, there are substantial enhancements in modern digital cameras as well as its resolution and sensitivity. Despite these improvements, quality of videos in low-light conditions is still limited. 2 considerable characteristics of an extremely low-light video are poor Dynamic range (D.R) and extremely low signal-to-noise (SNR). There are various techniques used to increase the dynamic range of a particularly low-light video. Most ordinarily used improvement technique is Dehazing algorithmic rule [2], [3], [17]. But, dehazing algorithmic rule depends on the atmospherical light and its transmission medium. Estimation of transmission term in the hazy image acquisition model by using dehazing algorithmic rule becomes unreliable in extraordinarily lowlight conditions. Wave coefficients [11] primarily based video improvement may also be used for improvement. However it's very high computational time. Another improvement technique is tone mapping [4], [5] followed by a Gamma Correction. For obtaining a much better video output quality, histogram equalization (HE) [6], [10] followed by gamma correction are often used.

Several video denoising techniques are employed in video process. Most ordinarily used video denoising technique is Spatio-temporal filtering [7] and bilateral filtering [3]. Spatio-temporal filter aims only the videos slightly less than the traditional lighting conditions. Since this methodology wasn't originally aimed to low-light video improvement task, some of the steps used, like optical flow and segmentation, may not give reliable results with low-light videos. Most of the denoising techniques need additional machine time. Recently, a 3 stage process theme for denoising and enhancing dark videos were projected. it's a changed version of the standard nonlocal means that (NLM) filter for removing noise in Associate in Nursing input video before and once tone-mapping by a power mapping perform. a higher denoised output for terribly low-light video is provided by Kalman filter approach [1], [10], and [16]. Kalman filtering is predicated on the prediction and correction of video frames and most of the video noises is removed by this methodology.. An extremely low-light video can be enhanced efficiently by the use of Gamma correction. Kalman filter and NLM filter can be used to get a better denoised video output.

II. Literature Survey

Minjae Kim et al.[1] "A Novel Approach for Denoising and Enhancement of Extremely Low-light Video", In this paper, the characteristics of low-light videos captured in an extremely low lighting condition are analyzed, and an effective framework to enhance them is proposed. The proposed framework exploited a motion adaptive temporal filter based on Kalman filter theory and adopted an NLM denoising filter for further smoothing after tone-mapping. The separation of temporal and spatial filters in the proposed noise reduction scheme provides more visually pleasing results than the conventional spatio-temporal filters while preventing ghost effects around moving object regions. An adaptive histogram adjustment using Gamma correction with clipping thresholds is also presented to increase dynamic range of a low-light video. The proposed tone-mapping enhances visibility of a low-light video significantly while maintaining its color balance. Various experimental results indicate that the proposed video enhancement method is highly promising for consumer digital cameras, especially CCTV, black box

camera for vehicles, and video signal-based surveillance system.

Jasmine K Mathew et al.[2] "Noise Suppression and Enhancement of an Extremely Low – Light Video", In this work, the characteristics of low-light videos captured in an extremely low light condition are analyzed. The proposed method consists of a denoising technique and an enhancement technique. The extremely low-light videos have very limited PSNR and dynamic range. By applying Kalman filter approach, it removes most of the noises from the video. The enhancement technique is done by tone mapping approach. Tone Mapping includes a gamma correction and histogram equalization. Most of the noises are removed from the video by Kalman filter. The remaining amplified noises are removed by NLM filter approach. The experimental results shows that, the output video of the proposed work have high PSNR and a noticeable enhancement. Also, the computational time is very less. Extremely low-light video denoising and enhancement is based on uncompressed videos. It uses two filters namely Kalman filter and NLM filter for denoising. A PSNR of 25 can be obtained by this method.

Qiang Guo et al.[3] "An Efficient SVD-Based Method for Image Denoising", In this paper, we have presented a simple and efficient method for image denoising, which takes advantage of the nonlocal redundancy and the LRA to attenuate noise. The nonlocal redundancy is implicitly used by the block-matching technique to construct low-rank group matrices. After factorizing by SVD, each group matrix is efficiently approximated by preserving only a few largest singular values and corresponding singular vectors. This is due to the optimal energy compaction property of SVD. In fact, the small singular values have little effect on the approximation of the group matrix when it has a low-rank structure. The experimental results demonstrate the advantages of the proposed method in comparison with current state-ofthe-art denoising methods.

P.Manju et al.[4] "Extremely Low-light Video Denoising and Enhancement with Tone mapping and Filters", The enhancement of the videos taken in low light conditions will be more helpful in the surveillance applications. The enhancement of the low resolution video frames based on tone mapping process and also noise removal process is applied. The performance measures proves that the proposed method is efficient compared to the existing works .The noise removal process were employed based on different types of filters. This system provides details on the average PSNR and runtime comparisons for a few of standard sequences artificially noise-corrupted. All the PSNR data achieved by the two- step algorithm are better than those by NLM, containing high motions which can be compensated by methods suggested. The videos taken in low intensity were taken and the videos were enhanced without any deviations in the original color information. The noise reduction process was also included along with the tone mapping process. Non local Means (NLM) filter and Kalman filter were employed for the filtering of the video frames. For tone mapping of the videos Gamma correction is employed which does not affect the original color information in the video. In the existing works the noise reduction is not employed while tone mapping is employed. The performance of the process is measured based on the performance metrics like PSNR, SSIM, GCF, NIQE calculation. The performance measures proves that the proposed method is efficient compared to the existing works. The previously used methodologies are able to reduce the noise as well as increase the contrast level of the video but used methods are not still effectively work on color video. In this way our expect to get clear video from the low light video. The methodology is extremely broad and adjusts to the spatiotemporal power structure keeping in mind the end goal to avoid movement obscure and smoothing crosswise over essential basic edges. The method also in clues sharpening feature which prevents the most important object contours from being over-smoothed. Most parameter scan is set generally for a very large group of input sequences. These parameters include: the clip-limit in the contrast-limited histogram equalization, the maximum and minimum widths of the filtering kernels and the width of the isotropic smoothing of the structure tensor and in the gradient calculations.

Antoni Buades et al.[5] "A non-local algorithm for image denoising", in this propose a new measure, the method noise, to evaluate and compare the performance of digital image denoising methods. We first compute and analyze this method noise for a wide class of denoising algorithms, namely the local smoothing filters. Second, we propose a new algorithm, the non local means (NL-means), based on a non local averaging of all pixels in the image. Finally, we present some experiments comparing the NL-means algorithm and the local smoothing filters.

III. Methodology

From the surveys, it is clear that most of the video denoising techniques require more computational time. A better denoised output will be given by Kalman filter and NLM filter. Similarly, tone-mapping provides a better enhanced output. In this work, tone-mapping includes gamma correction and histogram equalization. Most of the video noises are removed by Kalman filter. The remaining amplified noises are removed by NLM filter.

The proposed work includes three steps. The diagrammatic representation of the proposed work is given in Fig. 1. B.

Extremely Low Light Videos: Two major characteristics of low-light videos are high level of noise (i.e., low SNR) and low dynamic range. Since these characteristics influence mutually on both denoising and tone mapping performances, they should be analyzed deliberately before developing low-light video

enhancement technique. There are various kinds of noises present in a low light image. They are shown in Fig. 2

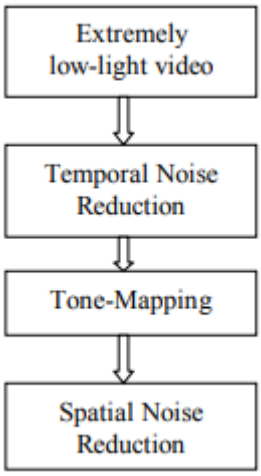

Fig.1 Block diagram of the proposed method

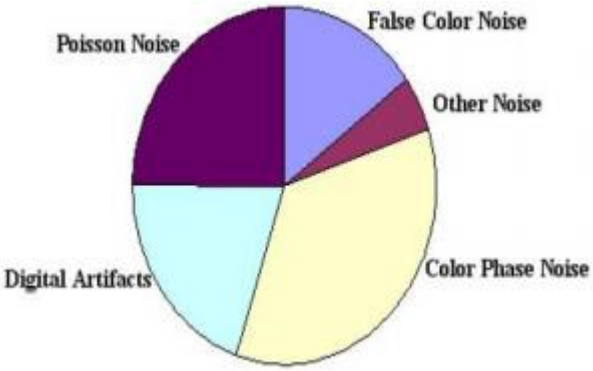

Fig.2 Elements of camera noise

From the Fig 2, it is clear that color phase noise is the important noise present in the image. It is a random fluctuation in the image caused by time domain instabilities (jitter).In video and television, noise refers to the random dot pixel pattern that is superimposed on the picture. As a result of electronic noise, the "snow" that is seen with poor (analog) television reception. Interferences and static are other forms of noise, in the sense that they are unwanted, though not random, which can affect radio and television signals. The characteristics of extremely low-light video can be studied from its histogram. For an example, extremely low light video frame and its corresponding histogram is shown in Fig 3. Most of the pixels in an extremely low light video are assigned to a very narrow region with low intensities. Also, the shapes of histograms of each color channels are almost identical. As the illumination level is decreased, the peak of histogram moves towards the zero, thus it becomes an "L-shape".

IV. Conclusion

This paper gives a review on Denoising and Enhancement of Extremely Low-light Video and related work as per survey report many work a enlisted in literature work. In [1] characteristics of low-light videos captured in an extremely low lighting condition are analyzed, and an effective framework to enhance them is proposed. The proposed framework exploited a motion adaptive temporal filter based on Kalman filter theory and adopted an NLM denoising filter for further smoothing after tone-mapping. In [2] applying Kalman filter approach, it removes most of the noises from the video. The enhancement technique is done by tone mapping approach. Tone Mapping includes a gamma correction and histogram equalization.

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