DENOISING OF LOW LIGHT VIDEO USING WAVELET FILTER: A REVIEW

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Abstract— Video quality enhancement is a long standing area of research. Noise is dominant factor that degrades image quality. Video denoising is a challenging topic in image processing; its main aim is to achieve an efficient, adaptive and high quality video. Noise reduction and enhancement of extremely low light video have poor dynamic range. Dynamic range of denoised video is increased by adjustment of RGB histogram. Several types of filters are used to remove noise from video. Noise is removed using a nonlocal means (NLM) denoising filter. Usually the success of any algorithm depends on the method that helps to improve the quality of image.

Index Terms— Video denoising, wavelet filter, Low light video, Non local mean.

1 INTRODUCTION

VIDEO Video denoising is the process of removing noise from a video signal. Video denoising methods can be divided into three types:-

i. Spatial video denoising methods, where image noise reduction is applied to each frame individually.

ii. Temporal video denoising methods, where noise between frames is reduced.

iii. Spatial temporal video denoising method use a combination of spatial and temporal denoising. This is often referred to as 3D denoising. Video denoising methods are designed and turned for specific types of noise. Denoising is still one of the most fundamental, widely studied, and largely unsolved problems in image processing. The purpose of denoising is to estimate the original image from noisy data. There have been substantial improvements in modern digital cameras including resolutions and sensitivity.

Despite these improvements, quality of videos in low light conditions is still limited. Firstly, low light videos have poor dynamic range. To capture images of high dynamic range, most consumer cameras often rely on automatic exposure control, but longer exposure time results motion blur. Secondly, image sequences captured in low-light conditions often have very low signal to noise ratio. Various approaches are developed for enhancing low light video. Most of the approaches introduced only for videos under moderately dark conditions in which most objects and background are almost visually recognizable.

Two major characteristics of low light video is high level of noise and low dynamic range. Motion compensation may be used to avoid ghosting artefacts when blending together pixels from several frames. Spatial Temporal video denoising methods use a combination of spatial and temporal denoising. This is often referred to as 3D denoising. Video denoising methods are designed and tuned for specific types of noise. Some of the earliest methods of denoising are simple averaging filters such as mean, median, Gaussian smoothing filters, and bilateral filters.

2 RELATED WORK

Several works have been carried out by researchers on the concept of video denoising. In review it is found that temporal noise reduction, tone mapping and spatial noise reduction methods are most widely used by many researchers. S.Pizer, e. Amburn [1] suggested an approach that constructs a structure of adaptive anisotropic image filter that is called "3D structure tensor", but this method become unstable and produces blurry results, when illumination level become very low.

C. Tomasi [2] C. Wang [7] suggested a spatio temporal connective filter and adaptive piece wise mapping function for input video. They combine local image statics into bilateral filter to form noise reduction filter but this methods was not for low light video, so may not provide reliable result with low light video.

The following figure shows the overall framework for extremely low light video.

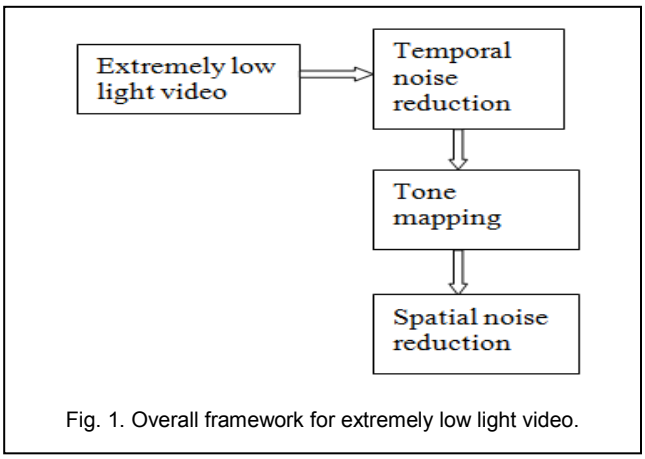

Fig. 1. Overall framework for extremely low light video.

S.W.Lee, V. Maik [3] suggested above the concept of noise adaptive spatio temporal filter that consider both Poisson noise and false color noise of input videos. Because their method aims only to videos slightly lower than normal lighting conditions, enhancement of input dynamic range is omitted.

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A Buades [4] and Q. Xu [8] utilize a modified version of the well-known nonlocal means (NLM) filter for removing noise in an input video before and after tone-mapping by algorithmic mapping function, but this will take lot of time.
Bennett and McMillan [5] developed an enhancement framework for low dynamic range video based on a virtual exposure camera model. Their method includes the bilateral ASTA-filter and tone-mapping with a logarithmic function applied to a large scale and detail features separately.
H. Malm, M. Oskarsson [6] suggested 3D structure tensor for adaptive spatio-temporal Smoothing and contrast limited histogram equalization (CLHE) for tone-mapping. But their method becomes unstable and produces blurry results when illumination level becomes very low because of inaccurate estimation of the anisotropic kernel from input signals with very low SNR.
A. Loza and D. Bull [9] suggested above the concept of noise adaptive spatio temporal filter that consider both Poisson noise and false color noise of input videos. Because their method aims only to videos slightly lower than normal lighting conditions, enhancement of input dynamic range is omitted.
More recently, new approaches applying the concept of a single image de-hazing algorithm [14] on the intensity inverted low-light video were presented by Dong et al. [10] and Zhang et al. [13]. These methods are developed under an observation that statistics of an intensity inverted low-light video are similar to those of a hazy video. However, the estimation of a transmission term in the hazy image acquisition model by using a dark channel prior (DCP) becomes unreliable in very low-light conditions and requires large computation loads.
T. Liu and J. Zhao [11] suggested that under extremely low-light conditions, signal level becomes very low, therefore readout noise is the dominant component but FPN can be removed with flat fielding or dark frame subtraction.
P. Chatterjee [12] and M. Kim [15] is aimed to developed a novel framework to enhance video from extremely low light environment, for this purpose they require additional artefact and this will take a lot of time.

3 Analysis Of Problem

In the past work following problems were discovered:-
i. Although there have been substantial improvement in many cameras including resolution and sensitivity, but quality of videos in low light condition is still limited.
ii. Low light video have poor dynamic range.
iii. To capture video using high dynamic range, most camera uses automatic exposure control but longer exposure time result in motion blur.
Various approaches were developed to improve the quality of video but every approach has some drawbacks.
i) Required longer time for improving quality of videos
ii) Color balance problem.
iii) Unstable and produce blurry result when illumination level become very low.
iv) May not provide reliable result.
v) Computational cost is very high.
vi) Accuracy problem.

4 Conclusion

After reviewing the work of different researches it has been observed that the main purpose of all of these methods is to reduce the noise from the video and to improve the quality of video. In video denoising, quality of video is very important. As there are some drawbacks in these discussed methods it is required to have some efficient method to improve the quality of video. This will be done with the help of histogram equalization with gamma correction followed by applying wavelet transform on it so as to remove the noise, color balance, accuracy problem and enhance the quality of it.

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