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The Video Enhancement System Based on Trilateral Filter

A.Vinothkumar, M.Anand, D.Jayakumar, S.Nandakishor

Abstract: The visual capacity of an image and video are deteriorates seriously by the huge noise levels commencing obscurity and low powerful range. Recently in digital cameras there has essential work going on in video creating and enhancement. Still there is interest for performing video improvement, which focuses at enhancing videos visual aspects. Here we centre around two most regular imperfections: distortions by contrast and noise. For removing noise the trilateral filter were used. After removing the noise, the video is enhanced by the statistical data of frames using APMF. The results analysis exhibits that the proposed framework produce satisfying outcomes for mixed noise videos and low quality videos.

Keywords: Video enhancement, Trilateral filter, APMF, NCV.

I. INTRODUCTION

In human everyday life digital video is transformed into essential part. In recent years video enhancement becomes as functioning point in computer vision. Last couple of years there is a significance improvement in resolutions and affectability of computerized cameras. Regardless of these upgrades, be that as it may, current advanced cameras are as yet restricted in catching high unique range recordings in low-light conditions.

Capturing videos become a lot simpler. Video defects (blocking, bluring, noise, and contrast distortions) are regularly presented by numerous wild factors such as unprofessional recording practices of video, data misfortune in transmissions, unfortunate ecological lighting, device imperfections, and so forth. Thus, there is expanding interest for video upgrade method, which goes for getting better video visual characteristics, while attempting to hinder various ancient rarities. In this paper, we centre around two most regular imperfections, they are noises and contrast distortions. Some current programming has recently given noise removal and contrast improvement capacities. It is conceivable that a large portion of them present curios and couldn't give adequate outcomes to a broad classification of videos. Up to this point, video improvement still remains a difficult research issue in separating noise and an expanded differentiation.

The common noises in recordings are very intricate [1, 2]; yet, the majority noises can be characterize in two noises they are Impulse and Additive Gaussian noise.

Additive Gaussian noises for the most part accept zero-mean Gaussian appropriation and are generally presented during obtaining the video, where as impulse noise presuppose uniform or discrete appropriation and is regularly brought about by transmission inaccuracy. In this way, filters can be planned focusing on these noises. Gaussian noise is very much smothered by anisotropic diffusion [4], wavelet-based approaches [5], bilateral filter [3], or fields of experts [6] while looking after edges. Impulse noise filters lay on powerful image measurements to recognize noise pels and fine highlights and frequently need an iterative procedure to decrease false identification [7–9].

As to video noise evacuation, other than the raised issues, temporal data ought to likewise be contemplated on the grounds that it is more significant than spatial data on account of stationary scene [10]. Be that as it may, straightly averaging transient comparing pels to noise may present "ghosting" ancient in the sight of camera and object motion. Such antiquities can be expelled by motion remuneration and various calculations have been proposed with various computational intricacy [11]. In any case, serious motivation clamor will present unexpected pixel changes like movements and incredibly decline the exactness of movement remuneration. In addition, there are frequently insufficient comparative pixels for levelling in worldly ways, attributable to blemished motion remuneration. In this manner, an attractive video noise channel ought to recognize motivation pixels and motional pixels just as gather sufficient comparative pels adaptively from temporal to spatial bearings. For contrast upgrade following by noise separating, it is very hard to locate an all inclusive methodology for all videos attributable to their various qualities, for example, overexposed, underexposed, with huge fine highlights or with huge dark background. Although many difference improvement procedures have been proposed, , a large portion of them are unfit to consequently deliver palatable outcomes for various types of low-differentiate videos, and may create ringing antiquities in the region of the boundaries "washed-out" curios [12] while having monochromic foundation or noise over upgrade ancient rarities.

II. LITERATURE SURVEY

There has been a considerable amount of past work on noise filter and contrast improvement. A short survey on this segment and portray their basic contrasts with our work is done.

Numerous researchers place endeavours on expelling the two sorts of noises. Gaussian noise are removed by filters on anisotropic dissemination [4] or bilateral filter [3],

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A.Vinothkumar, Associate Professor, Dr.MGR Educational and Research Institute
M.Anand, Professor, Dr.MGR Educational and Research Institute
D.Jayakumar, Associate Professor, Kuppam Engineering College
S.Nandakishor, Associate Professor, Kuppam Engineering College

these two are indistinguishable numerical models. These techniques smoothen Gaussian noise well however did not evacuate to expel impulse noises attributable to regarding them as edges.

In this way, Kober et al. [8] presented a spatially connected neighbourhood for identification of noise, by the relation between of pixels with their adjacent, like our NCV measurement. Yet, their result just measured the pixels of CNBH, not at all like our own that use all neighboring pels to describe the structures of fine highlights. Besides, it should be carry out itera`tively to address false identification, in contrast to our single-step strategy. using a fuzzy filter removing mixture noise was measured by Peng and Lucke [1].

Perona and Malik in 1990, [15] displayed Scale-space and edge discovery utilizing anisotropic dispersion method for reduction of noise . Lee, Kang [16] exhibited a method for example 3D and spatiotemporal decrease of noise in video. In [17] and [18], the purported formation tensor or next moment grid so as to break down the nearby spatial-temporal power structure and steer the smoothing in like manner. Malm and Warrant [19] displayed an approach for versatile improvement and noisedecrease for exceptionally dim picture arrangements with low powerful range in 2007.

Qing Xu1 [21] exhibited a new three-arrange calculation for denoising of low-light video and upgrade in 2010. Another system for dull video denoising and upgrade has been acquainted and appeared with to a great extent progress current cutting best in class results. In 2010, X Dong et al [22] exhibited a novel, straightforward and viable upgrade calculation for low lighting video.

In 2012, Ravikumar et al [24] displays by utilizing FPGA based equipment to develop the computation speed of video upgrade. Jinhui [25] displayed a procedure of kinect profundity technique for low image upgrade. Pre-preparing for Kinect profundity map, profundity compelled nonlocal implies denoising and profundity mindful difference extending are performed progressively in this calculation to advance the visual quality.

A. Sri Krishna et al [26] displays broadly utilized image differentiate improvement strategy Histogram equalization (HE). Niraj K S[27] presented essential thought of use intra outline procedures accessible for still image improvement to create video upgrade methods. Intra casing Image upgrade procedures comprise of a gathering of systems that offers movement to get better the visual appearance or to change over the image which is appropriate for investigation by a human or machine. In 2014, Minjae Kim [28] proposed a novel system for upgrade of very lowlight video.

III. SYSTEM FRAMEWORK

The contribution to upgrade framework of video is an imperfect video blended with Gaussian and impulse noises and having an outwardly bothersome difference. We accept to form the information video V is produced by including the Gaussian G and impulse I noises to a suppressed video . Therefore, the info video is written by

V = L+G+I. -------------------------(1)

Here. Given the info imperfect video, the assignment of video upgrade framework is to consequently create a yield video V', which has outwardly contrast and a smaller amount noise. The framework can be characterized by a process f2 which is noise removal and a process f1 i.e., contrast enhancement as

V` = f1(f2(V)), where L ≈ f2(V) ---------------------(2)

Figure 1 explains the framework of proposed video enhancement system

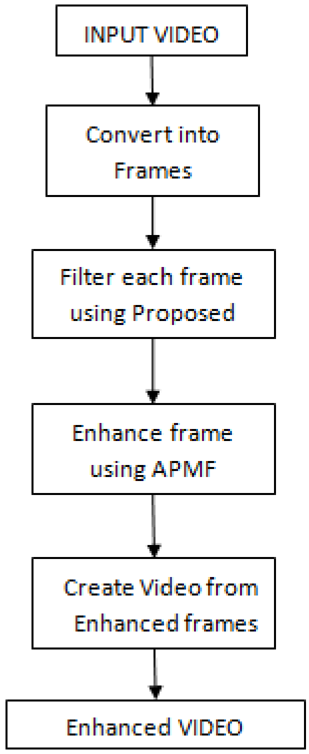

Fig. 1 System framework of video enhancement system

IV. NEIGHBORHOOD CONNECTIVE VALUE (NCV)

The pels in insignificant lights are neither like neighboring pixels nor having little inclinations in any event 4 headings [2, 14], and in this manner will be misclassified as noises [2, 14]. Comparing signal pixels and noise pixels we embrace the powerful suspicion that impulse noise pixels are in every case no associated with neighbors [8]. In view of this suspicion, we present a novel nearby measurement for motivation noise discovery NCV, by calculate the "connective quality" of a pel to the various pels with its neighbors. So as to present NCV clearly, let pxy means the pel with directions (x, y) in an frame, and Vxy indicates its intensity.

Let take two neighbor pels p_{xy} and p_{ij} fulfilling $d = |x - i| + |y - j| \leq 2$, their connective value (CV) is characterized as

$$CV(p_{xy}, p_{ij}) = \alpha \times e^{-(v_{xy}-v_{ij})^2/2\sigma_{CV}^2}$$

---------- (3)

W here α approaches 1 when d = 1, and equivalents 0.5 when d =2. σ_{cv} is a parameter to punish exceedingly various intensities.

A *way P* from pel p_{xy} to pel p_{ij} is a progression of the pels $p_1, p_2, \ldots, p_{np}$, where $p_1 = p_{xy}$, $p_{np} = p_{ij}$, p_k and p_{k+1} are neighbor pels ($k = 1, \ldots, np-1$).

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The PCV is the result of CVs of *every single* neighbor pairs along the path P

$$\mathrm{PCV}_P(p_{xy}, p_{ij}) = \prod_{k=1}^{nP-1} \mathrm{CV}(p_k, p_{k+1}).$$

---------- *(4)*

PCV depicts the smoothness of a way; the more comparative the forces of pels in the way are, the bigger the way's PCV is. PCV achieves 1 when all pixels in the way have indistinguishable power.

The local connective value (LCV) of a innermost pel p_{xy} with the pel p_{ij} in its neighbor window is the biggest PCV of the considerable number of ways from p_{xy} to p_{ij}

$$\mathrm{LCV}(p_{xy}, p_{ij}) = \max_{p}(\mathrm{PCV}_p(p_{xy}, p_{ij}))$$

---------- *(5)*

The neighbor pels will be pels in a $(2k + 1) \times (2k + 1)$ window, meant by $W(p_{xy})$, with p_{xy} as the centre. The NCV of a pel *pxy* is the entirety of LCVs of all its neighbor pels

$$\mathrm{NCV}(p_{xy}) = \sum_{p_{ij} \in W(p_{xy})} \mathrm{LCV}(p_{xy}, p_{ij})$$

--------------- (6)

NCV gives a proportion of "connective quality" of a focal pel to all its neighbor pels.

V. TRILATERAL FILTER

Video is composite of images, including. NCV is a decent measurement for impulse noise exposure, through the bilateral filter well smothers Gaussian noise[2]. Accordingly, we consolidate NCV into the bilateral filter to frame a trilateral filter so as to expel mixed noise.
For a pel *pxy*, its new-fangled intensity $v`_{xy}$ after bilateral filtering is registered as

$$v'_{xy} = \frac{\sum_{p_{ij} \in W(p_{xy})} \omega(p_{xy}, p_{ij}) v_{ij}}{\sum_{p_{ij} \in W(p_{xy})} \omega(p_{xy}, p_{ij})}$$

$$\omega(p_{xy}, p_{ij}) = \omega_S(p_{xy}, p_{ij}) \omega_R(p_{xy}, p_{ij})$$

-------------- (7)

where $\omega_S(p_{xy}, p_{ij}) = e^{-((x-i)2+(y-j)2)/2\sigma 2S}$ and $\omega_R(p_{xy}, p_{ij}) = e^{-(vxy-vi\,j)2/2\sigma 2R}$ represent spatial and radiometric weights,respectively [2].

In temporal connective trilateral TCT filter, the neighbourhood window of a pel p_{xyt} *is* defined as $W(p_{xyt})$, which is a $(2m+1)$ length window in sequential direction with p_{xyt} as the center. the TCT filter is work out as

$$v'_{xyt} = \frac{\sum_{p_{ijk} \in W(p_{xyt})} \omega(p_{xyt}, p_{ijk}) v_{ijk}}{\sum_{p_{ijk} \in W(p_{xyt})} \omega(p_{xyt}, p_{ijk})}$$

$$\omega(p_{xyt}, p_{ijk}) = \omega_S(p_{xyt}, p_{ijk}) \omega_R(p_{xyt}, p_{ijk})^{1-J(p_{xyt}, p_{ijk})} \times \omega_I(p_{ijk})^{J(p_{xyt}, p_{ijk})},$$

---------- (8)

$$\omega_S(p_{xyt}, p_{ijk}) = e^{-((x-i)^2+(y-j)^2+(t-k)^2)/2\sigma_S^2}$$

$$\omega_R(p_{xyt}, p_{ijk}) = e^{-(v_{xyt}-v_{ijk})^2/2\sigma_R^2}$$

where and ω_I and are defined as

$$\omega_I(p_{xy}) = e^{-(\mathrm{INCV}(p_{xy})^2)/2\sigma_I^2}$$

$$J(p_{xy}, p_{ij}) = 1 - e^{-((\mathrm{INCV}(p_{xy})+\mathrm{INCV}(p_{ij}))/2)^2/2\sigma_I^2}$$

----------- (9)

For enhancement we use adaptive piecewise mapping function [20].

VI. EXPERIMENTAL RESULTS

For outcome analysis, proposed methods are tested on noise videos. These strategies took diverse preparing time depends on the size of the of info video. Table 1.Shows the information about input video.

Table. 1 Details of Video input

Input video name	xylophone.mpg
Video Duration	4.70 sec
Video Height	320
Video Width	240
Total no of frames	141

Figure 2 shows 10th frame of the input video xylophone.mpg. Figure 3 shows the noisy input video. Here we took histogram equalization method along with proposed method. Figure 4 shows video enhancement of histogram equalization method. Figure 5 shows trilateral filter output. After filtering adaptive piecewise mapping function was used for enhancing. The enhanced video is shown in figure 6.

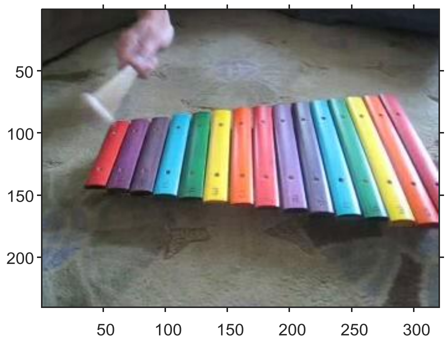

Fig. 2 Original frame

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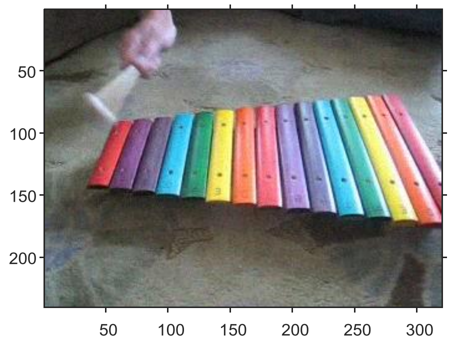

Fig. 3 Noisy frame

Fig. 4 Video enhancement using histogram method

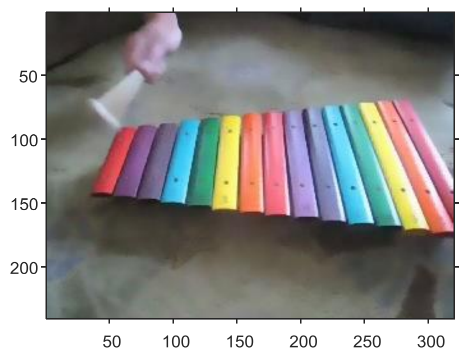

Fig. 5 Noisy removed frame using trilateral method

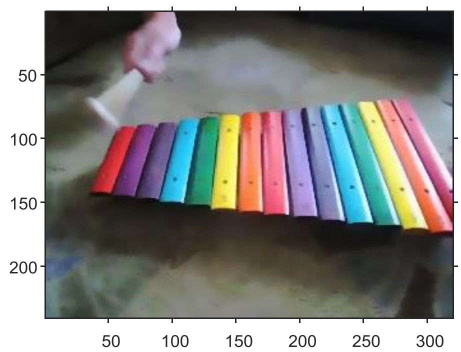

Fig. 6 Enhanced video after applying filter.

Table 2 shows the comparison results of proposed method with histogram equalization. The PSNR value of Histogram method is around 42dB and for proposed method is 54dB. The PSNR value shows that the proposed method removes the noisy efficiently and enhance the video in satisfaction .

Table. 2 Comparison results of proposed method with histogram equalization

Frame No	Histogram Equalization PSNR	Proposed Method PSNR
1	41.8251	54.5509
5	41.9521	54.5702
10	41.7251	54.1254
25	41.9521	54.5702
50	41.2536	54.0265
70	41.8251	54.5509
90	41.9521	54.5702
110	41.7251	54.1254
125	41.2536	54.0265
140	41.9521	54.5702

VII. CONCLUSION

In this paper, an inclusive video upgrade system is introduced, which can enormously smother the most two normal noises just as essentially improve video contrast. We present NCV to get better impulse noise location execution all things considered. At that point, we join it into the bilateral filter structure to reduce mixed noises. In this work techniques which are utilized are exceptionally encouraging for real time applications to shopper computerized cameras, particularly CCTV and the observation video framework. The proposed framework gives strategies to play out an improvement just on degraded frames or noisy frames. The framework conveyed the quality yield when it contrasted and input video. At last framework can upgrade unwatchable videos into worthy film.

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