

Video Enhancement For Low Light Environment

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Abstract—Digital video has become an integral part of everyday life. It is well-known that video enhancement as an active topic in computer vision has received much attention in recent years. In this paper we are basically focusing on enhancement of video that taken into the low light conditions for this Video footage recorded in very dim light is especially targeted. Enhancement of low-light video is done by noise reduction; motion adaptive temporal filtering. Dynamic range of denoised video is increased by applying RGB histograms base on adaptive adjustment. In color image data, the chromaticity is restored of raw RGB input data is performed simultaneously with the noise reduction. Finally due to the high level of noise edges and textures are often over-smoothed during the denoising process. Remaining noise is removed using Non-local means (NLM) denoising.

Index Terms— Denoising, Low light video, Noise reduction, Non-local mean, Tone mapping, Video enhancement

I. INTRODUCTION

From last few years, there have been abundant capability improvements in digital cameras including resolutions and sensitivity. Even with these improvements, the modern digital cameras are still limited in capturing high dynamic range images in challenging light conditions. These Cameras generally rely on automatic exposure control to capture images of high dynamic range, but the longer exposure time frequently results motion blur. Additionally, image sequences captured in low-light conditions often have low signal-to-noise ratio (SNR). When the illumination is very low, the level of noise becomes relatively higher than the signal, so conventional denoising techniques are inefficient to provide the noiseless image sequences hence they cannot be applied. Therefore apart from conventional methods some different approaches are developed for enhancing low-light video, however most of them consider video from averagely dark conditions.

As Noise removal and video enhancement play a critical role in many applications – such as surveillance – involving videos taken under very poor light conditions: they set a very challenging problem due to poor dynamic range and high noise level. While processing of very dark videos is expected to benefit from the adoption of the most flexible available algorithms, their specific adaptation to the case of low dynamic range videos remains largely untouched Many

approaches are developed for enhancing low-light video, however most of them consider video from moderately dark conditions. In this project, we aim to develop a enhance video from extremely low-light environments. Our method consists of temporal noise reduction, tone-mapping, and Non-local means denoising. All steps are implemented to handle the color filter array raw data and provide the effective results.

II. LITERATURE REVIEWS

Minjae Kim¹, Student Member, IEEE, Dubok Park¹, David K. Han², and Hanseok Ko¹ [1] proposed a novel framework for enhancement of very low-light video. For noise reduction, motion adaptive temporal filtering based on the Kalman structured updating is presented. Dynamic range of denoised video is increased by adaptive adjustment of RGB histograms. Finally, remaining noise is removed using Non-local means (NLM) denoising. The proposed method exploits color filter array (CFA) raw data for achieving low memory consumption. Histogram adjustment using the gamma transform and the adaptive clipping threshold is also presented to increase the dynamic range of the low-light video. The experimental results indicate that this method is highly promising for real time applications to consumer digital cameras, especially CCTV and the surveillance video system.

Henrik Malm Magnus Oskarsson Eric Warrant [2] presented a methodology for adaptive enhancement and noise reduction for very dark image sequences with very low dynamic range. A general methodology for noise reduction and contrast enhancement in very noisy image data with low dynamic range is presented. Video footage recorded in very dim light is especially targeted. Smoothing kernels that automatically adapt to the local spatio-temporal intensity structure in the image sequences are constructed in order to preserve and enhance fine spatial detail and prevent motion blur. In color image data, the chromaticity is restored and demosaicing of raw RGB input data is performed simultaneously with the noise reduction. The method is very general, contains few user-defined parameters and has been developed for efficient parallel computation using a GPU. The technique has been applied to image sequences with various degrees of darkness and noise levels, and results from some of

these tests, and comparisons to other methods, are presented. The present work has been inspired by research on vision in that allows these animals to see in dim light.

Qing Xu^{1, 2}, Hailin Jiang¹, Riccardo Scopigno³, and Mateu Sbert⁴ [3] presented a novel three-stage algorithm for very-low-light video denoising and enhancement. The proposed technique invokes twice, in the first and the third stages, the well-known Non-Local Means (NLM) method for spatial and temporal denoising: it is well adapted to the application, leading to the definition of a novel NLM tool. The intermediate stage performs a custom tone adjustment specifically aimed at enlarging the dynamic range of very dark videos. The overall approach transforms very dark videos into more watchable ones, effectively reduces very high noise, and all in all, produces high quality restored image sequences outperforming the recent state-of-the-art results. Additionally, the first and third stages can be combined as a two-step filtering scheme for normal-light videos: the novel denoising solution achieves a heavy noise removal, while reducing motion blur artifacts and preserving image details.

Jinhui Hu, Ruimin Hu, Zhongyuan Wang, Yan Gong, Mang Duan [4] presented a technique of Kinect depth based method for low light surveillance image enhancement. Pre-processing for Kinect depth map, depth constrained non-local means denoising and depth aware contrast stretching are performed successively in this algorithm to promote the visual quality for low light surveillance image. Comparing with the previous works, this method is able to enlarge the low dynamic range and promote both global and local depth perception for the low light surveillance image meanwhile. The experimental results show that this method generates clearer object edges and more distinct depth perception for enhanced low light surveillance images. High noise level from darkness and low dynamic range are two characteristics of low light surveillance image that severely degrade the visual quality.

Xuan Dong, Jiangtao (Gene) Wen, Senior Member, IEEE, Weixin Li, Yi (Amy) Pang, Guan Wang [5] presented a novel integrated algorithm for realtime enhancement of video acquired under challenging lighting conditions. Such conditions include low lighting, haze, and high dynamic range situations. The algorithm automatically detects the dominant source of impairment, then depending on whether it is low lighting, haze or others, a corresponding pre-processing is applied to the input video, followed by the core enhancement algorithm. Temporal and spatial redundancies in the video input are utilized to facilitate real-time processing and to improve temporal and spatial consistency of the output. The proposed algorithm can be used as an independent module, or be integrated in either a video encoder or a video decoder for further optimizations

III. PROPOSED WORK

The video enhancement is still an active area of research by many experts. There are still many problems of video

enhancement because of the following reasons (i) we are unable to extract moving objects from the dark background. Due to low contrast, if the color of the moving objects and that of the background are the same then most color-based methods will fail on this matter (ii) The signal to noise ratio is usually very low (iii) The information carrying video signal is degraded due to acquisition process, or the rate and format conversion processes. (v) Inter-frame coherence must also be maintained i.e. the moving objects region as weights in successive images should change smoothly. (vi) One pixel from a low quality image may be important even if the local variance is small. (vii) The video device used is of poor quality and lack of expertise of the operator. The most important part of a video security surveillance system is video enhancement. During night operations, more details and integrated information from the enhanced image are required. However, low quality video of most surveillance cameras is not satisfied and difficult to understand because they lack surrounding scene context due to poor illumination. So one of the major problems is image/frame fusion problem to ensure better image reconstruction and color assignment. Hence a large number of techniques has been proposed to overcome this problem. In this work we are considering the existing methods of video enhancement, which can be made better enhancement of video taken in poor visibility light condition. The desired outcome of the project is to enhance video. The steps to get the desired outcome are as shown in the following figure

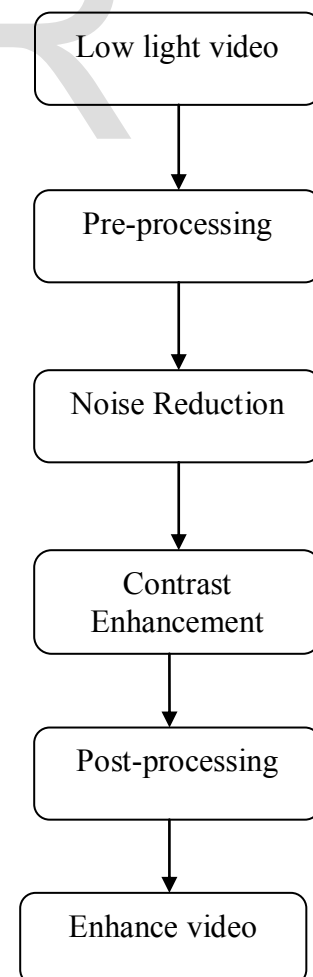


Figure 1. Steps for low light video enhancement

A. Pre-processing

The first stage is Pre-processing and low light video is applied to this stage as an input. Pre-processing is the term for executions on images at the lowest level of abstraction. These executions do not increase image information content but they decrease it if entropy is an information measure. The Main function of pre-processing is an improvement of the image data that reduces undesired distortions or enhances some image features in video appropriate for further processing and analysis task. Pre-processing use the redundancy in images. So this is the first stage of video enhancement that is basically working on the suppression of unwanted data.

B. Noise reduction

One of the major quantity that affecting the quality of the video is noise .Noise is the consequence of errors in the image recovery process that result in pixel values that do not reflect the true intensities of the real scene. Since image sequences are temporally correlated, noise can be reduced effectively by temporal filtering. Because of temporal (inter-frame) filter can exploit the correlation to obtain high noise attenuation . In the working areas of the video frames it cannot be applied as it is because it creates a motion blur. In order to identified the true noise the temporal filter may use. Most of the noise is removed by the temporal filtering The output from first stage is given to the noise reduction. Noise reduction is the process of removing noise from a signal. Hence we can say that the noise is undesired quantity that must be removed.

C. Contrast enhancement

After the temporal noise is reduced, we amplify intensity of low-light video by the second stage which nothing but the Enchantment stage in which the applied input from predecessor is enhance by some different methods . in this stage we applied the RGB based algorithm that based on histograms .This RGB based algorithm work according to the histogram mapping technique computed separately by grouping pixels of each color channel from a CFA image Then, they can converted with adaptively selected low and high clipping thresholds. To map dark pixels to a bright level, we are adopting Gamma transform with value of gamma less than 1. Because most of pixels have very small intensity values ranging about 5% of maximum intensity in extremely low light conditions, stretching all pixels may cause an undesired transformation with a high offset intensity. By mapping pixels below the peak of histogram and pixels with intensity beyond top 99th percentile, we can obtain satisfactory tone-mapped result. Enhancement processes adjust the relative brightness and darkness of objects in the video in order to improve their visibility.

D. Denoising method

The final step of low light video enhancement smoothening we mention it into the figure 1. as post-processing.at this is final stage of the process we have to apply an effective spatial filter for smoothening the remaining noise. Even though most of the noise is removed by the temporal filtering and noise reduction, the noise is exaggerated by tone mapping step.

Moreover, since the level of the noise is much higher in the low light environment, edges and textures are often over smoothed during the denoising process. we can used here Non-local mean(NLM) denoising method for better result

IV. CONCLUSIONS

In this work, we provided an effective method to enhance an extremely low-light video. We are using a motion adaptive temporal filter for primary enhancement and adopted the NLM denoising for further smoothing. Effective Histogram adjustment using the gamma transform and the adaptive clipping threshold is also presents to increase the dynamic range of the low-light video. Hence The main objective of video enhancement is to improve the visual appearance of the video can achive by these methods .It will provide a “better” transform representation for future automated video processing such as analysis,detection,segmentation,recognition, surveillance,traffic, criminal justice systems we can also used it in real time applications to consumer digital cameras, especially CCTV and the surveillance video system.

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