BALANCED LIGHT ENHANCEMENT IN IMAGES WITH MODIFIED HISTOGRAM AND RETINEX COMBINATION: REVIEW

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***Abstract*: From last few years, there has been substantial work on video processing and wide improvements being carried out in video processing including resolutions and sensitivity. Despite these improvements, still there is a problem to capture a high dynamic range videos and videos in low-light conditions especially when light is very low. If the intensity of noise is higher than the signal then the conventional de-noising techniques cannot work properly. For the said problem there are many approaches being developed for low-light video enhancement but still Low contrast and noise remains a barrier to visually pleasing videos in low light conditions. To capturing videos in concerts, parties, social gatherings, and in security monitoring situations are still an unanswered problem. In such conditions the video enhancement of low quality video is a really tedious job. This paper is elaborating a survey of different type of methods and technologies that have been used and implemented in the area of video enhancement. The study is further going on to find a technique so that more accuracy can obtained in video enhancement.**

***Keywords*: Video Enhancement, quality assessment, enhancement algorithm, low light videos, noise, filter, video enhancement.**

I-INTRODUCTION

Over the previous couple of years, there has been a depth in capability improvement were take place in digital cameras within the space of resolutions and sensitivity But still there is limitation in modern digital cameras in capturing high dynamic range videos in low-light situation [1]. Noise in video frames creates the serious poverty of video quality [3]. The noise remains as large residual errors after motion compensation [3]. The typical digital cameras can only capture videos with a dynamic range of thousands in magnitude just because of that limited dynamic range of digital cameras, poor visibility causes due to overexposure in bright regions and underexposure in dark regions of a captured video [4]. During processing of very dark videos mostly specific algorithms being adopted for enhancement process which causes of low dynamic range videos remains largely untouched [5]. It is always expected that the digital camera should work effectively in all types of lighting and whether condition but the majority of these cameras are failed to capture videos and videos in low light state, hence the low quality of videos and videos being captured [6]. The prime intention of video enhancement is to bring out detail information that is hidden in video [7]. Video up gradation or enhancement may be defined as to give an input of low light or low quality video and collect the high quality video output for specific applications. Videos are the integral part of our life and that's why it's an active subject which brings much attention in recent years [10]. Color of the objects with similar background, low intensity of light (low light condition) and the unknown level of darkness while capturing a video, make it more complicated [10]. This investigation is going to present a survey of different types of methods and technologies that have been used for video enhancement and will help to design and develop a technology which will deliver more accuracy in video enhancement.

II-LITRATURE REVIEW

Low Light Video Enhancement by Temporal Noise Reduction and Non-local means de-noising: Local Mean filter take the mean value of group of pixels surrounding to target pixel to smooth the video where as "Non Local Means" filtering take a mean of all pixels in the video, weighted by how similar those pixels are to the target pixels. If the video sequences are temporally correlated, noise can be reduced effectively by temporal filtering [1] because of temporal (inter-frame) filter can exploit the correlation to achieve high noise attenuation [10]. In the working areas of the video frames it cannot be applied as it is because it creates a motion blur. In respect to identified the true noise the temporal filter may use. Most of the noise is removed by the temporal filtering and the remaining noise can be exaggerated by the Non-local means de-noising. The level of noise is much higher in low-light environment, edges and textures are often over smoothed during the de-noising process.

Tone Mapping: Tone mapping is a technique used in video processing and computer graphics to map one set of colors to another to approximate the appearance of high dynamic range video in a medium that has a more limited dynamic ranges. Tone mapping is the process of amplify intensity of low-light video by judicious histogram adjustment [1]. Mostly three types of histograms of RGB color are computed separately after grouping pixels of each color channel from a CFA (color filter array) video, and then they are transformed with adaptively selected low and high feature thresholds [1]. System use transform value which should be less than 1 to map dark pixels to a bright level. Because most of pixels have very small intensity values ranging about 5% of maximum intensity in extremely low light condition, stretching all pixels causes an associate degree incorrect conversion with a high offset intensity. By clipping pixels below the highest value of histogram and pixels with intensity beyond top 99th percentile, system can obtain satisfactory tone-mapped result while color balance is retaining always better than the result generated [1]. The principle behind the tone mapping process is to extend the dynamic range of dark video areas and meanwhile it slightly affected in other areas. If system wish to deliver an output in high dynamic range (HDR) video on paper or on a display, there must somehow convert the wide intensity range in the video to the lower range supported by the display [6]. The tone mapping technique is operated on brightness level (luminance) [7].

Histogram equalization: Histogram Equalization is video processing technique. Greater is the histogram stretch greater is the contrast of the input video [2]. Histogram Equalization is one of the foremost familiar, computationally quick and straightforward to implement techniques for video enhancement but it mostly prefer for contrast enhancement of digital videos [3]. A histogram is a graphical representation of the distribution of data while a video histogram is a graphical representation of the number of pixels in a video as operate of their intensity. The HE Histogram equalization technique is used to stretch the histogram of the input video. If the distinction of the video is to be exaggerated then it means that the histogram equalization distribution of the corresponding video has to be widened. Histogram equalization is that the most generally used enhancement technique in digital video process because it deliver better result and cleanness in output that other [3]. The histogram of an input video is generally refers to a histogram of the pixel intensity values. The bar graph may be a graph showing the amount of pixels in a picture at every totally different intensity worth found therein video. For an 8 bit grayscale video there are 256 different possible intensities are available and so that the histogram will graphically display 256 numbers showing the distribution of pixels amongst those grayscale values. Histograms take input as color picture and may provide individual demonstration of red, green and blue color channels of histograms [3]. It tries to change the special bar graph of a picture to closely match the same distribution. The main aspire of this process is to obtained a uniform distributed histogram by using the cumulative density function of the given video. HE consist of following advantages such as,

- It suffers from the problem of being poorly suited for retaining local detail due to its global treatment of the video.
- Small-scale details that are often associated with the small bins of the histogram are eliminated [6].

Adaptive Intensity Transfer Function: The intensity-transfer function realized in the proposed algorithm is a tunable nonlinear transfer function for providing dynamic-range alternate arrangement adaptively. To attain this level a hyperbolic tangent function satisfies the condition of continuous differentiability. Another improvement of the hyperbolic tangent function is that the output value always comes in the range from zero to one for any positive input. It guarantees that output always follow the desired range of value. The adaptive hyperbolic tangent function characterized by the local statistical characteristics of the video where- as proposed intensity-transfer function is local tone mapping operator. The purpose of this task is to improve the low intensity pixels while preserving the stronger pixels [4].

Spatial Domain Techniques: Spatial domain techniques directly operate on video pixels where noise reduction is applied to each frame individually. Exploitation of given pixel values are done to attain the desired improvements. Spatial domain techniques such as the Logarithmic Transforms, Histogram Equalization and Power Law Transforms, are all based on the direct manipulation of the pixels values available in video. This technique is applicable in the area of directly altering the gray level values of individual pixels and the overall contrast of the entire video [5].

Point Operation: Point operations are applied to individual pixels only.
Mask Operation: In mask operation, each pixel is modified according to neighborhood pixel values.
Global Operation: All pixel values are taking into consideration for performing operation [5].
Frequency Domain Techniques: Frequency domain techniques are based on the manipulation of the orthogonal transform of the video rather than the picture itself. A frequency domain technique is based on the frequency content of the video [1]. The concept used by frequency domain technique for video enhancement is to compute a 2 dimensional structure of a video. For instance the 2-D DFT, manipulating the transform coefficients by an operator and then performing the inverse transform. The Magnitude and Phase are the two components of an orthogonal transform of the video. The frequency content is available in magnitude whereas the phase is used to reset up the video back to the spatial domain [4]. The standard orthogonal transforms are discrete cosine transform, discrete Fourier transform and Hartley Transform. The frequency content of the video enables to transform domain operations, therefore high frequency content such as edges and other suitable information can easily modified [5].

Contrast enhancement: Video enhancement techniques involve processing a video or video frame to make it superior in terms of visibility. The superior quality is achieved by modifying contrast or dynamic range or both in a video or video frames [6]. The main objective of contrast enhancement process is to adjust the local contrast in different regions of the video or video frames, so that the details in dark or bright regions are brought out and disclosed to the human viewers. Contract enhancement is mostly applied to given video frames or videos to archive a superior visual representation of the video by transforming original pixel values using a transform function [6]. The contrast enhancement is performed using a technique almost like to auto-leveling the contrast of low-light videos [11].
Context based fusion Enhancement: The intention behind the use of context-based video enhancement is to extract and fuse the meaningful information of video sequence captured from a fixed camera under different light conditions [6]. Context-based fusion means to insert high quality information from the same scene such as to overcome bright regions and blurred details to improve the low quality video. The information which is being gathered and analyzed from multiple videos (scenes) is used for video up gradation purpose [6]. Using context based fusion the information is automatically combined in videos at different time intervals by video fusion. All the data and information from original low quality sources (scenes) is combining with high quality background scenes in same viewpoint [6]. There are so many methodologies were invented for video up gradation but low contrast and noise are major barrier to visually pleasing videos in low light conditions. Such conditions make it more complex and challenging. Hence

it has been realized that there is a wide scope to make an investigation in low light video enhancement specially to determine the intensity of individual pixel channel values and enhanced them as per the requirement.

Hyo-Gi Lee et al [3] In this paper, they propose a novel contrast enhancement algorithm for low light level videos, which preserves video details and color constancy based on Retinex. We decompose an input low contrast video into luminance and chrominance components in Lab color space, which reflects the perception characteristics of human visual system well, and enhance the luminance component only. We first estimate illumination using adaptive bilateral filtering, which guarantees the available range of reflectance by considering proper neighboring pixels according to their luminance and color values. Then we enhance the contrast of the estimated illumination video using parabolabased tone mapping function. Finally, the enhanced luminance and the original chrominance are combined together to yield an enhanced color video. Experiment results show that the proposed algorithm enhances video details and edge structures by alleviating halo artifacts, and also preserves naturalness faithfully by avoiding color shifting artifacts. In this work [3], they proposed a Retinex-based video contrast enhancement algorithm to preserve color constancy. We first decomposed an input video into luminance and chrominance components using Lab color space. Then we estimated the illumination by applying bilateral filtering adaptively according to the color similarity and luminance distribution among neighboring pixels. Moreover, we improved the contrast of luminance video by performing parabola-based tone mapping to the estimated illumination video. Finally, we generated an enhanced color video by combining the enhanced luminance and the original chrominance together. Experiment results demonstrated that the proposed algorithm enhances the contrast of input low contrast videos, while preserving video details and natural colors faithfully. However, when an input video has a very low light level, the proposed algorithm often yields an over-enhanced result. We will address this problem as a future work.

Xiaojie Guo et al [2] captures videos in low-light conditions, the videos often suffer from low visibility. Besides degrading the visual aesthetics of videos, this poor quality may also significantly degenerate the performance of many computer vision and multimedia algorithms that are primarily designed for high quality inputs. In this paper, we propose a simple yet effective low-light video enhancement (LIME) method. More concretely, the illumination of each pixel is first estimated individually by finding the maximum value in R, G and B channels. Further, we refine the initial illumination map by imposing a structure prior on it, as the final illumination map. Having the well-constructed illumination map, the enhancement can be achieved accordingly. Experiments on a number of challenging low-light videos are present to reveal the efficacy of our LIME and show its superiority over several state-of-the-arts in terms of enhancement quality and efficiency.

In this paper [2], they have proposed an efficient and effective method to enhance low-light videos. The key to the low-light enhancement is how well the illumination map is estimated. The structure-aware smoothing model has been developed to improve the illumination consistency. We have designed two algorithms: one can obtain the exact optimal solution to the target problem, while the other alternatively solves the approximate problem with significant saving of time. Moreover, our model is general to different (structure) weighting strategies. The experimental results have revealed the advance of our method compared with several state-of-the-art alternatives. It is positive that our low-light video enhancement technique can feed many vision-based applications, such as edge detection, feature matching, object recognition and tracking, with high visibility inputs, and thus improve their performance.

Fan Wu et al [1] To improve the quality of low-light video, they proposed a new HSI based enhancement algorithm. This new algorithm enhances the luminance of low-light level videos while preserving video contrast and details. First, the original RGB video is converted into HSI color space, then the intensity and saturation components are processed with different enhancement methods, but the hue component remains unchanged, the segmentation exponential enhancement algorithm is applied to saturation component S, then apply the histogram equalization to intensity component I and then the intensity component I is divided into high and low frequency sub-bands with wavelet transform, the Retinex algorithm is applied to the low frequency sub-band to adjust video luminance while the improved fuzzy enhancement is applied to the high frequency sub-band to enhance video details. Finally, reconstruct the component I with inverse wavelet transform, and the reconstructed component I will be synthesized with H and the enhanced S components to get a clear RGB video. By taking advantage of HSI color space and the improved enhancement algorithm, the enhancement of low illumination color video has been achieved. According to the experiment results, this algorithm can obviously improve the visual effect of low light color video.

In this paper [1], an enhancement algorithm for low-light videos is proposed. First, the video is transformed from RGB space to HSI space, and some effective algorithms are applied for the Intensity component and Saturation component in HIS color space for enhancement purpose. The segmented exponential transformation algorithm is used to let the video saturation become more suitable for the visualization of the human eye, and then apply the histogram equalization algorithm to the component I to enhance the video contrast. After using the histogram equalization algorithm, the enhanced video is processed by wavelet transform to get the low frequency sub-band and high frequency sub-band. Retinex algorithm is applied to the low frequency component to enhance the brightness of the video. The fuzzy enhancement algorithm is applied to the high-frequency components to make the edge of the video become clearer. The experimental results prove the validity of the proposed algorithm from both subjective and objective aspects after comparing with some existing algorithms.

Author/ Journal/ Year	Method	Outcome
Fan Wu, / IEEE Proceeding/2017	HSI Color Space developed along with Ratinex and Fuzzy enhancement for Low-Light Video Enhancement	Standard Deviation (STD) observe is 77.07, Gradient (Grad) is 29.19 and Entropy (Ent) is 7.87.
Xiaojie Guo / IEEE transactions/2016	Low-light Video Enhancement via Illumination Map Estimation	lightness order error (LOE) obtain is 2.394
Hyo-Gi Lee/ APSIPA ASC 2015	Color Preserving Contrast Enhancement for Low Light Level Videos based on Retinex	MSE observe is 0.35 and PSNR observe is 38.8703
Takuya Mikami/ ICIP 2014	capturing color and near-infrared videos with different exposure times for video enhancement under extremely low-light scene	MSE observe is 0.29 and PSNR observe is 36.24

III-CONCLUSION

This paper presents a survey of different types of methods and technologies that have been used for video enhancement. But the low contrast and noise remains a barrier to visually pleasing video in low light conditions. In that condition, to find out a more accuracy in video enhancement process there is need to detect and measure the intensity level of individual pixel channel as well as have to present an appropriate enhancement factor for enhancement purpose, so that effective and efficient video enhancement process will be created. In future, the video enhancement process will measure the intensity level of individual pixels channels and decide the best enhancement factor which might be random or constant depends on the requirement of video enhancement algorithm.

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