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Obtain the Intra-And-Inter Frame Quality of Video Based On Tone Mapping Algorithm

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Abstract: Video enhancement plays an important role in various types video applications. In this paper, we proposed a new intra and-inter-frame quality of video based on piece wise tone mapping approach aiming. This paper Two steps were incorporated in to the proposed work for object quality improvement. These are (i) intra frame quality step. improve intra frame quality ,first analysis features from different region-of-interest and a global tone mapping curve is created by fusing from other regions then the intra frame quality is improved .and (ii) inter frame consistency step aiming of this one is improve the inter frame quality implemented over histogram equalization method. We observed better improvement in PSNR values of the image and the reduction in MSE values over the existing techniques. Thus, the modified technique improves the video enhancement.

Keywords: Video Enhancement, Intra Frame, Inter Frame, MSE, PSNR, Tone Mapping.

I. INTRODUCTION

Video enhancement is very important in various video applications such as entertainment, healthcare, communication and surveillance is the examples for that Such as maintain the video quality and images from various parameters like video surveillance cameras, medical imaging, and also frames with different type of poor quality. The quality of video takes different number of frames in to applied enhancement and region of interest and also applied for calculating the Peak Signal to Noise Ratio (PSNR). Thus a good quality video can be delivered.

A. Intra Frame Quality Enhancement

The processes of the inter frame quality step can be further described by multiple ROIs are first identified from the input video frame. In this paper, we improving intra frame quality use video conferencing or video surveillance as example application scenarios and identify ROIs (such as human faces, screens, cars, and whiteboards) based on an AdaBoost-based object detection method. this is combine the number of week classifiers in to much stronger one[6]. Other Robust real-time object detection and saliency detection algorithms can also be adopted to obtain the ROIs.

B. Inter Frame Quality Enhancement

By using the start of the art algorithm only focus on improving the single frame quality or on image. Improve the brightness and color modeling of some specific regions. Other approaches, since color modeling is more subjective than brightness and contrast, it is difficult to come up with a quantitative formula to define what a visually appealing color modeling is. Therefore, existing approaches on example-based image enhancement often requires a user to select an example image. The image processing techniques being developed that improve the brightness and contrast of the captured images Exposure, however, is not the only affects the perceptual quality of a mobile cam video.

II. EXISTING METHODS

A. A+ECB Video Enhancement Algorithm

A+ECB algorithm is also known as intra and inter constraint based algorithm. It is the combination of intra and inter frame enhancement. Intra frame enhancement is known as ACB process and inter frame enhancement is known as ECB process. A+ECB algorithm analyzes features from different ROIs and creates a “global” tone mapping curve for the entire frame such that different regions inside a frame can be suitably enhanced at the same time. Furthermore, new inter frame constraints are introduced in the proposed algorithm to further improve the inter frame qualities among frames. Let us go detailed through the algorithm. The framework of our A+ECB algorithm can be described as in Fig1. In Fig1, an input frame is first enhanced by the proposed .ACB step for improving the intra frame quality. Then, the resulting frame will be further enhanced by the proposed ECB step for handling the inter frame constraints. The ACB step and the ECB step will be described in detail in the following.

III. PROPOSED METHODS

In this paper, a new algorithm is proposed to enhance the multiple regions of interest (ROIs) one after other in each frame of a complete video while maintain the inter frame consistency. The frame work of the proposed work is shown in Fig.2. The proposed work can be explained in three steps as mentioned as below:

- Preprocessing Steps.

- Intra Frame quality Steps.
- Inter frame consistency Steps

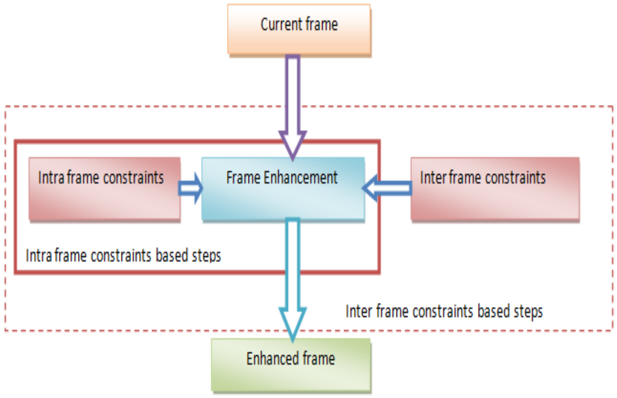

Fig.1. frame work of Existing A+ECB algorithm.

A. Preprocessing Steps

The first and foremost step for the proposed method is the preprocessing steps. This preprocessing steps involves the frame conversion of the input original video. Then each frame is resized to the 256 X 256 size for easy computations. Then each frame is converted to black and white image and then labeled image is obtained from it with 8 connectivity point. The labeled image is obtained so as to form the multiple ROIs. Each frame can contain many ROIs. Each ROI is identified through an area measure.

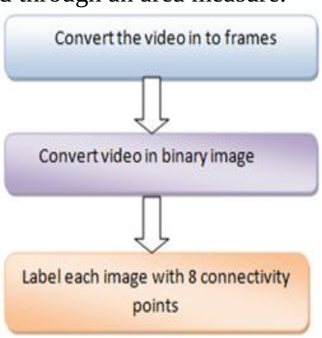

Fig. 2. pre processing of video enhancement.

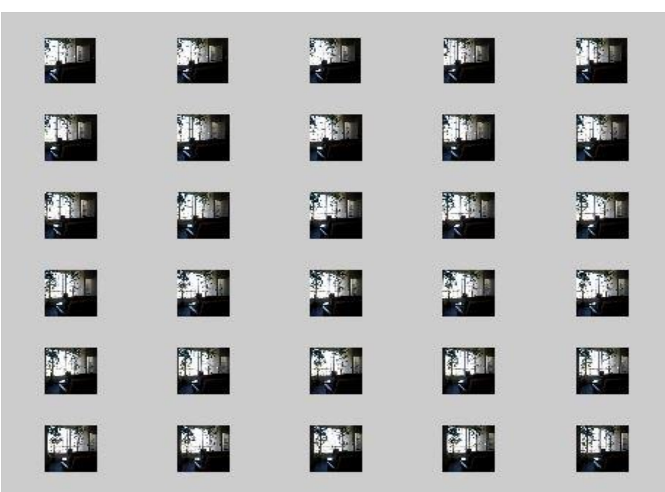

Fig. 3. frames of the input original video.

The fig.3 shows the frames of the input video totally we have 30 frames, then the speed of the conversion is 30 frames per second.

B. Intra Frame Quality Steps

In this step, the intra frame quality is improved. The multiple ROIs are identified in the earlier step are fed as input to this step. Here, each ROI in each frame is tone mapped to obtain the enhanced frames. The tone mapping is a technique that converts the high dynamic range images to low dynamic range images that are suitable for display. In this intra frame quality step each ROI is enhanced one after another in each frame. After enhancing every ROI present in one frame it passes to the ROI present in other frame. Thus, it achieves the Intra Frame Quality by enhancing each and every ROI present in all the frames. The process of the intra frame step can be further described by Fig. 4. In Fig. 4, multiple ROIs are first identified from the input video frame. In this paper, we use video conferencing or video surveillance as example application scenarios and identify ROIs (such as human faces, screens, cars, and whiteboards) based on an AdaBoost-based object detection method [6]. Other object detection methods and saliency detection algorithms can also be adopted to obtain the ROIs. Note that since our algorithm creates a global tone mapping curve for enhancement, these regions do not need to be perfectly extracted, as will be shown in the experimental results. After extracting and analyzing the features from these ROIs, a global tone mapping curve is created by fusing these features from different regions. Finally, the enhanced frame by this global tone mapping curve can simultaneously provide appealing qualities for different ROIs. It should be noted that the creation of the global tone mapping curve is the key part of our algorithm.

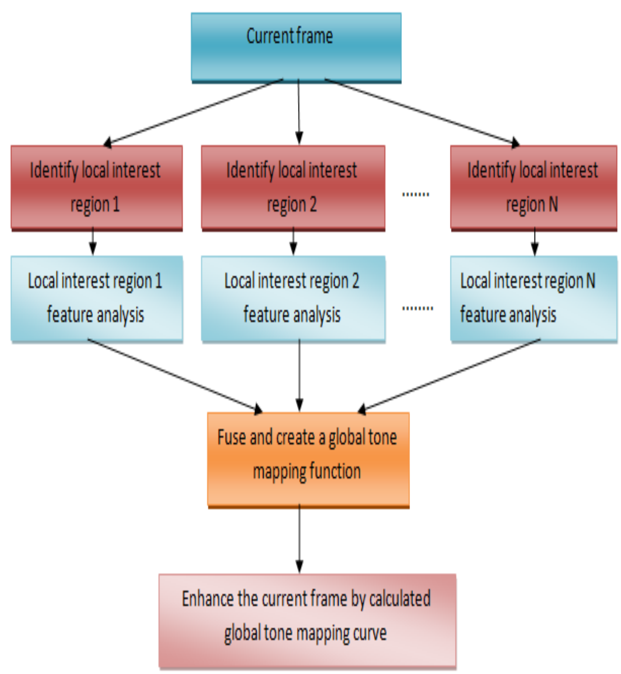

Fig.4. intra frame quality work process.

The HEM method can be described as (1). Instead of using the histogram distribution to construct the tone mapping function directly, the method formulated a weighted sum of two objectives as

$$h = arg\,\min_{h^*}(|h^* - e|^2 + \delta|h^* - \mu|^2) \quad \textbf{(1)}$$

Where μ is the uniform distribution, h is the desired color histogram, h^* is the possible candidate of h, and e is the color histogram by traditional HE. δ is a parameter balancing the importance between μ and e [4]. From (1),the desired h can be achieved by

$$h = \left(\frac{1}{1+\delta}\right).e + \left(\frac{\delta}{1+\delta}\right).\mu \quad \textbf{(2)}$$

Based on (2), a tone mapping function can be calculated that enhances the original image to the desired color histogram h [4]. The basic idea of the HEM method is that by introducing another constraint $i.e(|h^* - \mu|^2)$, the unnatural effects in the HE can be effectively reduced. However, the HEM method is still an intra frame-based method that does not consider the temporal continuities among frames. In order to handle inter frame consistency, we can extend (1) by including an additional inter frame constraint by

$$h = arg\,\min_{h^*}(|h^* - e|^2 + \delta.|h^* - \mu|^2 + \gamma.|h^* - h_{t-1}|^2) \quad \textbf{(3)}$$

Where h_{t-1} is the desired color histogram of the previous frame $t-1$ and γ is another balancing parameter handling the importance of the inter frame constraint.

In order to create global tone mapping curves, features need to be first extracted and analyzed for each ROI. In this paper, we utilize a simple but effective method by extracting the mean $mR_{i,j}$ and the standard deviation $\sigma R_{i,j}$for each ROI Ri and for each color channel j (we use R-G-B color channels and perform enhancement in each channel independently). However, note that our algorithm is general and the feature extraction as well as the color channel processing modules can also be implemented by more sophisticated ways. For example, if one ROI include multiple major colors, we can also view each major color region as a "sub-ROI" and pre fuse these sub-ROI features before fusing with other ROIs. Furthermore, the correlation constraints among color channels can also be included when performing enhancement for each color channel [4], [5], [9]. For the ease of description, we focus on discussing the global tone-mapping-curve creation from only two ROIs $(i.e\, RA and\, RB)$in this paper. The global curve creation from more ROIs can be easily extended in an iterative way (i.e., fuse two ROIs at each time and then view the fused ROIs as an entire ROI for later fusion). The Intra frame strategy for fusing multiple ROI features and for creating the global tone mapping curve can be described by

$$f_{g,j}(x) = \begin{cases} f_{g,j}^{PB}(x) if\left(m_{RA,j} + \delta.\sigma_{RB,j}\right) - \left(m_{RA,j} - \delta.\sigma_{RB,j}\right) < TH \\ f_{g,j}^{FB}(x) if\left(m_{RA,j} + \delta.\sigma_{RB,j}\right) - \left(m_{RA,j} - \delta.\sigma_{RB,j}\right) \geq TH \end{cases} \quad \textbf{(4)}$$

Where$f_{g,j}(x)$ is the fused global tone mapping curve for intra frame enhancement in color channel j. x is the color level value $f_{g,j}^{PB}(x)$is the tone mapping curve by the piecewise based strategy for color channel j and$f_{g,j}^{FB}(x)$is the curve by the factor-based strategy. $mR_{i,j}$and $\sigma R_{i,j}$are the mean and the standard deviation for ROI $R_i$in color channel j.

In this paper, we assume that $m_{RA,j} < m_{RB,j}$. TH is a threshold and δ is a parameter for reflecting the separability of the two ROIs. In our experiment, TH is set to be 50 and δ is set to be 1 based on the experimental statistics. From (3), we can see that if the features of the two ROIs RA and RB are different from each other [i.e., the pixel values for regions RA and RB seldom overlap and can be roughly separated: $(m_{RA,j} + \delta.\sigma_{RB,j}) - (m_{RA,j} - \delta.\sigma_{RB,j}) < TH$the fused global curve$f_{g,j}(x)$ will take the piecewise-based form$f_{g,j}^{PB}(x)$ Otherwise, $f_{g,j}(x)$ will take the factor-based form $f_{g,j}^{FB}(x)$. The basic idea of our piecewise-based curve-fusion strategy $f_{g,j}^{PB}(x)$can be described as follows; if the features of the two ROIs RA and RB are different from each other , then the fused global tone mapping curve$f_{g,j}(x)$ can be divided into two parts, where each part can be tuned to suitably enhance the quality of its corresponding ROI as shown in Fig.6. More specifically, $f_{g,j}^{PB}(x)$can be described

$$f_{g,j}^{PB}(x) = \begin{cases} f_{RA,j}(x), & if\ x \in [0, P_c\ ] \\ f_{RB,j}(x), & if\ x \in [P_c\ ,225] \end{cases} \quad \textbf{(5)}$$

Where $f_{RA,j}(x)$and$f_{RB,j}(x)$ are the piecewise tone mapping parts corresponding to the local ROIs RA and RB, respectively.

Fig.5. (a) Original image. (b) Image enhanced by the piecewise strategy without constraint factor-based strategy. (c) Image enhanced by the piecewise based

strategy with constraint. (d) Image enhanced by the factor-based Strategy. Best viewed in color.

The fig.5(a) is the original image, when identify two ROI's for enhancement the left car and road .and the fig(b) is the examples to show the the necessity of using the factor based strategy when ROI's features are similar fig(c) is the enhancement results by the piecewise based strategy without derivate constraints. fig(d) is the results by the factor based strategy is our regular tone mapping curve .

Fig. 6. Experimental results of Intra frame quality step for identified different ROIs.

C. Interframe Consistency Steps

In the above step the intra frame quality is obtained. The above step may disturb the temporal quality consistency as shown in Fig.7. The temporal quality consistency is improved through the inter frame consistency step. In this step, the tone mapping technique is applied on every enhanced frame obtained in the above step. After the tone map function is applied, the histogram of obtained tone mapped image is equalized. This histogram equalization makes every frame to be high contrast image. Thus, the inter frame consistency is maintained among all the frames of the video. All the enhanced frames are arranged to obtain the enhanced video. The Inter frame step can be implemented by the HEM-based framework as mentioned in [3]. In our paper, besides [3], we also propose another Inter frame step described contrast image correction method by [11]. It should be noted that both [3] and [11] are based on the same inter frame enhancement idea discussed as follows:

$$f^{A+E}_{g,j}(x) = \left(1-\delta^{EA}_j\right).f_{g,j}(x) + \delta^{EA}_j.f^{A+E}_{preg,j}(x) \quad \textbf{(6)}$$

Where $f_{g,j}(x)$ is the intra frame global tone mapping curve from(4). $f^{A+E}_{preg,j}(x)$ is the tone mapping curve by the proposed method in the previous frame. EA is the balancing parameter with the inter frame constraints embedded, calculated by

$$\delta_{EA} = \max\left(arg^{min}_{\delta^*_{EA}}|E(t) - E(t-1)|, LB \right. \quad \textbf{(7)}$$

Where $E(t)$is the entropy of frame t and it can be calculated

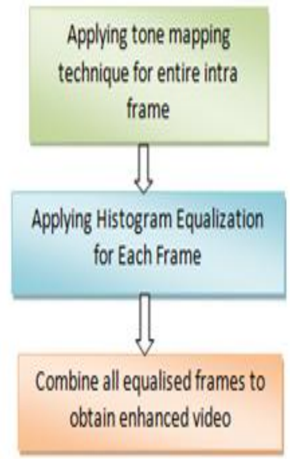

Fig.7. Inter frame consistency to obtain enhanced video.

$$E = \sum_k -p(k).\log_2 p(k) \quad \textbf{(8)}$$

Where $p(k)$ is the histogram value at bin k. Note that a lower bound LB is defined in [12] to ensure that the inter frame constraint can be effective in controlling the inter frame consistencies. LB is set to 0.5 in our experiment. From [11]– [13], we can see that this ECB strategy embeds the inter frame constraints in the balancing parameter δ_{EA}such that results of the Intra frame step can be shifted to a relatively stable intensity level. Thus, the visual qualities in each frame can be kept coherent and the inter frame discontinuity can be effectively reduced.

Fig.8.experimental results of Inter frame consistency Step output Frames.

IV. EXPERIMENT RESULTS

The proposed work implemented on various videos to evaluate the performance of it. The input video is taken in AVI format size of the video is 704kb, frame width and height 320*240, data rate is 6232kbps, total bit rate 6338kbps, frame rate is 30 frames/second. When the input video is given as input, first it converts to number of frames and identifies the ROIs present in each frame. The each and every identified ROI of a frame is enhanced by applying tone mapping technique. Multiple ROIs identified in each frame is shown in Fig.4. The enhanced entire frame to maintain the inter frame consistency is shown in Fig.6. The performance parameters that are calculated in order to evaluate the performance of the proposed work are the discrete entropy (H), temporal absolute mean brightness error [TAMBE (μ)] and the standard deviance of the difference image between the neigh- boring frames [TAMBE (σ)]. In general, large H values reflect good intra frame qualities while small TAMBE (μ) and TAMBE (σ) values imply good inter frame qualities. The Table1 shown below compares the performance measure of ACB and ECB with the proposed intra and inter frame Quality method.

TABLE I: Performance Parameters Comparison For Different Methods

parameters	Original video	Existing methods		Proposed method		
		HEM	LB	Intra frame	Inter frame	Tone mapping
Entropy(H)	6.5119	6.6017	6.52	6.69	7.10	7.173
TAMBE(μ)	2.6188	2.2	2.4	2.28	1.4214	1.3094
TAMBE(σ)	2.9575	2.8	2.11	0.1396	0.112	0.0756
HIBTE	0.292	0.285	0.33	0.248	0.309	0.149

Fig.9. Comparison between the existing and proposed method of original video sequence (corresponding first and seventh frame of original video).

In the table 1 shown above that the discrete entropy (H) is greater in proposed work compared to the intra frame and inter frame algorithms. Thus, this shows that the proposed algorithm performs well to improve the intra frame quality of the video. Similarly, the measures TAMBE (μ) and TAMBE (σ) shows small values compared to the existing, intra frame and inter frame algorithms. And the HIBTE shows the small value compared to the existing methods. Thus, this shows that the proposed algorithm not only improves the intra frame quality of the video but also guarantees the inter frame quality among the frames of the video. The fig. 8 indicates the comparison between the frame of the different methods. the first column images indicates the original input video and the middle column frames indicates the enhanced video frames by histogram equalization modification methods and last column images indicate the enhanced video frames by our proposed tone mapping method best viewed in color.

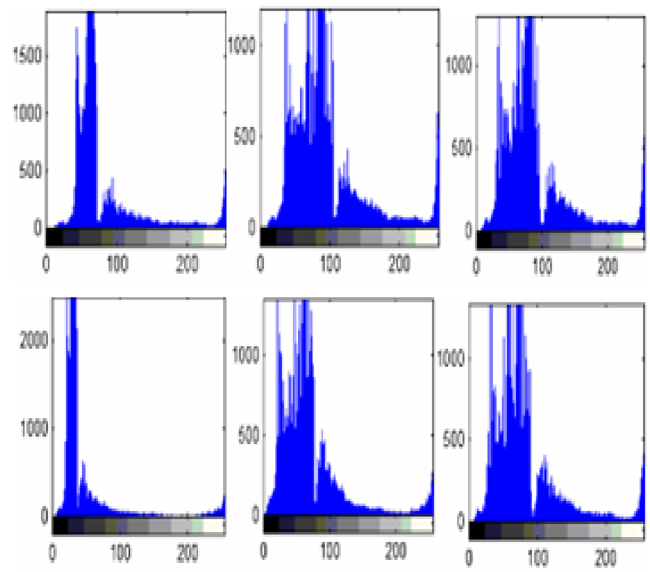

Fig.10. Histograms of the images in Fig8.

In fig8:the first column images are the first and seventh frame of our original input video sequence ,and the second column images are the enhanced video sequence obtained by the HEM method. The third column images are the enhanced video sequence obtained by applying the our proposed tone mapping technique best viewed in color. And fig.9 indicates the histograms of the corresponding images in fig.8.

A. Peak Signal to Noise Ratio (PSNR) & Mean Square Error (MSE)

It is an expression for the ratio between the maximum possible value (power) of a signal and the power of distorting noise that affects the quality of its representation. Different image enhancement algorithms were compared systematically to identify whether a particular algorithm produces better results and PSNR stands between 40-80 dB The mathematical representation of the PSNR is as follows:

$$PSNR = 20log_{10}\left(max_f \middle| \sqrt{MSE}\right) \quad (9)$$

$$MSE = \frac{1}{mn}\sum_{0}^{m-1}\sum_{0}^{n-1} \| f(i,j) - g(i,j) \|^2 \qquad \textbf{(10)}$$

This can also be represented in a text based format as follows.

MSE = (1/(m*n))*sum(sum((f-g).^2))

PSNR = 20*log(max(max(f)))/((MSE)^0.5)

$f(i,j)$ is matrix data of original image

$g(i,j)$ is the matrix data of degraded image

'm' is the numbers of rows of pixels of the images and 'i' represents the index of that row, 'n' represents the number of columns of pixels of the image and 'j' represents the index of that column. max_f is the maximum signal value that exists in our original image.

TABLE II: Mean Square Values and Peak Signal To Noise Ratios Of Different Frames In Video

Frames	Existing methods		Proposed method	
	MSE	PSNR	MSE	PSNR
Frame 1	4.2273e+03	64.21537	3.2273e+03	74.2157
Frame10	4.0752e+03	68.62833	3.0722e+03	74.6433
Frame15	5.9861e+03	71.83642	2.9861e+03	74.8902
Frame20	4.0717e+03	54.64445	3.0717e+03	74.6447
Frame25	4.1958e+03	64.29245	3.1988e+03	74.2928
Frame30	4.3597e+03	51.91345	3.3397e+03	73.9182

VI. CONCLUSION

In this paper, we concluded the inter frame quality and intra frame quality of entire video stream enhanced. Different ROIs are identified the entire frame such that the quality of a frame can be properly enhanced. In this paper, we proposed a new intra and inter quality algorithm for video enhancement. The proposed method analyzed features from different ROIs and created a "global" tone mapping curve for the entire frame such that the intra frame quality of a frame can be properly enhanced. Furthermore, new inter frame constraints were introduced in the proposed algorithm to further improve the inter frame qualities among frames. Experimental results demonstrated the effectiveness of our algorithm.

VII. ACKNOWLEDGMENT

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VIII. REFERENCES

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