Noisy Video Frames Contrast Enhancement for Multimedia Photo-Journalism

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Abstract: ***Video frames enhancement techniques for photographic, magazine and newsletter and multimedia journalists are a great challenge, especially in displaying or publishing a good quality of scenes from various kind of information sources because of poor contrast of brightness pictures from light sensitivity and noise such as impulse noise and Gaussian noise to an image caused by capture device (camera or scanner) defects and unprofessional video recording behaviors. Therefore, it is necessary to enhance the video frames for grayscale and true Color images and then, use as still images/pictures. Digital image enhancement techniques provide very large number of choices for improving the visual quality of images. There are various techniques of video frames enhancement and noise reduction. This paper contributes to combine the filter based and Successive Mean Quantization Transform (SMQT) algorithm for better image quality of digital video frames by minimizing properties such as gain and bias. We will measure the results by using Peak Signal-to-Noise Ratio (PSNR) to explain ratio between the higher and lowest possible values of a changeable quantity and we will implement these techniques by using MATLAB.***

Keywords: Adaptive Median Filter, Successive Mean Quantization Transform (SMQT)

1. Introduction

Video development is the one of the greatest process of the world, with its rapid growth, it has changed life of the people in many ways and after decades of development still keeps bringing new visual experiences. Video frames enhancement is the processing of enhancing certain features of some images from analog or digital video.

Multimedia journalists face the problems of representing clear photographs, provide information or journalistic reports from that oldest, noisy vision and poor brightness from light sensitivity of saved camera's photos and videos recorded that exist in the libraries for a long time. In other side, photo-journalists focus on the missing of some photographs events or sequences caused by delay of photo camera capturing, Analog sources of video and image are copied, they experience generation loss and low quality, noise and image degradation artifacts (S/N ratio) caused by compression formats which are often introduced by many uncontrollable factors such as information loss in video transmissions, device defects, and so forth [9]. This paper proposes an adaptive median filtering to eliminate impulse (salt and pepper) noise. While Successive Mean Quantization Transform (SMQT) algorithm for contrast stretching and reveals the structure of the data and removes properties like gain and bias [14].

2. Related Work

The aim of this paper to discuss about video frames enhancement but the reviews show both video and image enhancement existing techniques can be classified into two broad categories. Self enhancement and frame based fusion enhancement. Self enhancement is a technique in which video frames can enhance themselves automatically. This technique can be classified into two broad categories: spatial-based domain and transform-based domain. Spatial-based domain video enhancement operates directly on pixels [10]. The main advantage of spatial-based domain technique is that they are conceptually simple to understand, and the low time complexity which favors real time implementations. But this technique generally lacks in providing adequate robustness and imperceptibility requirements. Transform based domain video enhancement operates directly on the transform coefficients of the image, such as Fourier transform, discrete wavelet transforms (DWT), and discrete cosine transform(DCT). The basic idea in using this technique is to enhance the video by manipulating the transform coefficients. The advantage of transform-based video enhancement includes: Low complexity of computations, Ease of viewing and manipulating the frequency composition of the image, and the easy applicability of special transformed domain properties [10]. Table 1 shows the related works are previously implemented for video enhancement techniques.

Table 1: Various Video Enhancement Techniques [10]

Author and Year	*Enhancement Techniques*	*Application*
Mohammad (2010)	Super resolution techniques	Suitable for use in small processor devices.
Dongo Min (2011)	Weighted mode filtering	3DTV,3D object modeling, robot vision and tracking.
D.Bakkiya Lakshmi (2012)	Tone Adjustment	Identifying people, license plates etc.
Garima Yadav (2014)	CLAHE	Used in video Real time system.
Dongsheng Wang (2014)	Piecewise based CE	Field of our daily life application such as security monitoring etc.

These algorithms also provide nonlinear contrast enhancement to some extent. From (Purna Chandra Srinivas Kumar Gaddam Pratik Sunkara) described pre-existed algorithms like SMQT (Successive mean Quantization Transform), V Transform, histogram equalization algorithms to improve the visual quality of picture [11] and new global

Tone Mapping Operation (TMO) are proposed utilizing the nonlinear (SMQT) by Mikael Nilsson [14]. Historically, the concentration of impulse noise on an image is varied because impulse noise is a random noise. Therefore, there are regions of the image with high level of corruption, and low level of corruption. For an effective noise filtering process, a larger filter should be applied to regions. Therefore, many works, such as [1] and [2] have proposed methods that are able to adjust the size of the filter accordingly based on the local noise content. is known as adaptive median filter [3].

3. The Proposed Video Frames Enhancement

Generally, to design an effective quality video frames enhancement is a challenging. Many approaches are developed for enhancing low-quality video frames [11], however most of them consider video from moderately dark conditions or low dynamic range(LDR). A novel framework in this paper is to enhance video frames from extremely high noise and low contrast (darkness) to high brightness environments. The proposed methods consist of preprocessing to suppresses unwilling distortions or enhances by extracting video sequences to individual frame for further processing.

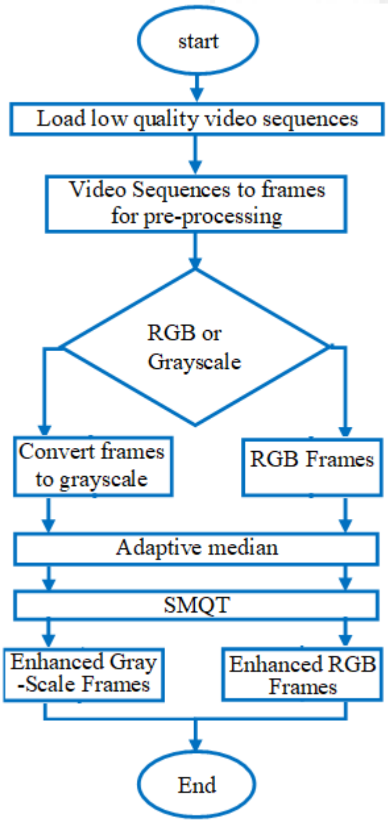


Figure 1: A Flowchart of the proposed algorithm for Video Frames Enhancement

3.1 Adaptive Median Filter

The adaptive median filtering has been introduced as an improvement to the standard median filtering. It performs spatial processing to preserve detail and smooth non-impulsive noise. Median Filter do not erode away edges or other small structure in the image [1][2]. The adaptive median filtering algorithm uses two processing levels, denoted level *A* and level *B:*

Level *A:* If $Z_{min} < Z_{med} < Z_{max}$, go to Level *B*
Else increase the window size
If window size <= S_{max}, repeat level *A*
Else output Z_{med}

Level *B:* If $Z_{min} < Z_{xy} < Z_{max}$, output Z
Else output Z_{med} [4].

The algorithm has three main purposes:

(a) To remove 'Salt and Pepper' noise.
(b) To smoothen any non-impulsive noise.
(c) To reduce excessive distortions such as too much thinning or thickening of object boundaries [1].

3.2 SMQT

Successive Mean Quantization Transform (SMQT) algorithm is a non-linear transformation that has the goal to get advantage of the whole dynamic range [14], but in a very different way as Histogram Equalization technique. This paper applies SMQT technique for both RGB and Grayscale video frames. The SMQT aims to remove the disparity between sensors due to gain and bias [6]. The SMQT can be used to extend structure representation to an arbitrary predefined number of bits on arbitrary dimensional data. The best results of the SMQT in an 8-bit image are obtained when using an 8 level SMQT. The basic unit of the SMQT is the MQU (Mean Quantization unit), which consists in calculating the mean value of all the pixels in the image, then the mean is used to quantize the value of data into 0 or 1 (D_0 or D_1), depending the value of the pixel is lower or higher than the mean. After doing this, the input split in two subsets [7].

$$D_0(x) = \{x \mid V(x) \le \overline{V}(x), \forall x \in D\} \quad (1)$$

$$D_1(x) = \{x \mid V(x) > \overline{V}(x), \forall x \in D\} \quad (2)$$

Where, $V(x)$ is the intensity of a pixel and $\overline{V}(x)$ is the mean value of the pixels.

D_0(x) propagates left and D_1(x) right in the binary tree [5] as shown in Figure 2.

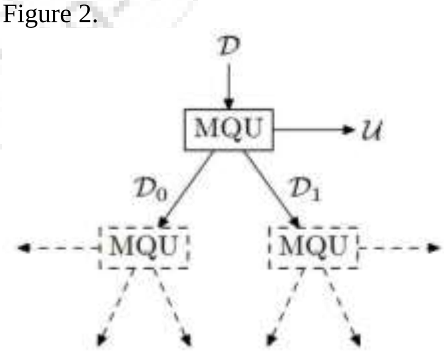


Figure 2: The operation of MQU [7].

Here MQU is not a similar value coefficient in this transform, the MQU constitutes the main computing unit for SMQT. MQU is independent to gain and bias adjustment of the input due *U*(x) (the output set at the root node) can be interpreted as the structure of D(x) will be follows accordingly. Let output set MQU denotes in tree as $U_{(l,n)}$ where l=1,2... L is current level and n is the number of output n = 1, 2... , [7] then final $SMQT_L$ can be found as [5],

International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

$$M(x) = \{x \mid V(x) = \sum_{L=1}^{L} \sum_{n=1}^{2^{l-1}} V(u_{(l,n)}) \cdot 2^{L-1}, \forall x \in M, \forall u_{(l,n)} \in U_{(l.n)}\} \quad (3)$$

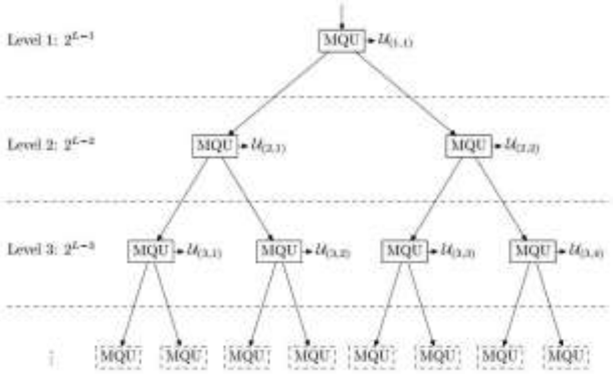


Figure 3: SMQT as a binary tree of MQUs [6].

In RGB images, the SMQT can be applied to the three RGB channels. Let $D_{(RGB)}(x)$ be all data values regardless of channel, then

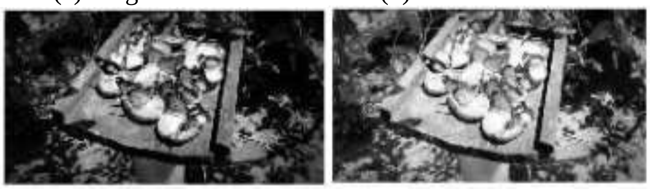
$$SMQT_L: D_{RGB}(x) \quad M_{RGB}(x) \quad (4)$$

This will result in a nonlinear contrast enhancement which preserves the order of the RGB values for each pixel, but with changed distances between the red, green and blue values within each pixels [8].

4. Experimental Results and Discussion

This section shows experimental results of the proposed video frames enchantment algorithm. The technique is based on combine noise reduction and contrast throughout the SMQT. By using MATLAB simulation for playing some compressed video clips in a .AVI file from online through various multimedia as data sets and then, to extract those video clips to video frames in JPEG format with the size 256-by-512. We opt two video clips for grayscale and two for RGB. Grayscale video frames are shown in Figure 4 and Figure 5 shows RGB video frames.

(a) Original Frame (b) Enhanced Frame



(c) Original Frame (d) Enhanced Frame

Figure 4: Grayscale video frames

(a) Original Frame (b) Enhanced Frame

(c) Original Frame (d) Enhanced Frame

Figure 5: RGB video frames

In this paper, we try to show PSNR and SSIM for both grayscale and color images. SSIM is designed by modeling any image distortion such as loss of correlation, luminance distortion and contrast distortion and the higher value of PSNR shows that the difference between the reference image and modified image is too low [13]. So, after applying the proposed technique to the original image we got a distorted image at a certain amount. Table 2 and Table 3 show the results for PSNR and SSIM.

Table 2: PSNR and SSIM for Grayscale frames

No:	Enhanced Frame	PSNR	SSIM
1	(b)	12.6016	0.7368
2	(d)	14.9130	0.6523

Table 3: PSNR and SSIM for RGB frames

No:	Enhanced Frame	PSNR	SSIM
1	(b)	22.0336	0.9106
2	(d)	15.7632	0.4554

5. Conclusion

This paper has discussed about noisy video frames contrast enhancement which is able to suppress the most common impulse noises as well as significantly enhance video frames brightness by using SMQT algorithm. In addition, PSNR and SSIM results show the effectiveness and improvement of contrast video frames enhancement. Also, the method develops better structural appearance of an image and also increased dynamic range of pixels. Therefore, this technique is not better only for multimedia photojournalism applications but, it can be also used for various kind of image recognitions that suffer from poor contrast and noises challenges during the process.

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