Video Enhancement using Tone Adjustment

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Abstract—Various video enhancement techniques have been proposed to make video frames better quality to human visual systems. The quality of video and images from various sources like video surveillance cameras, medical imaging, are in poor quality. To enhance the quality video by a simple and computationally efficient technique for video enhancement by tone adjustment technique is proposed. This technique is helpful in identifying people, license plates, etc. from poor quality video surveillance cameras. Simulation results show that the proposed technique achieve high contrast enhancement with low noise and great video quality.

Keywords—Bilateral tone adjustment, video enhancement, tone adjustment

I. INTRODUCTION

The dynamic range of natural luminance intensity can reach approximately 1010:1 while conventional printers or displays only show images in dynamic range Of 100–1000:1 [1]. It is due to the limitation of bit resolution in the video format and also in capturing devices. That inconsistency makes video details disappear if the background is too dark or too bright. Therefore, various video enhancement techniques are introduced to retrieve the hidden details in video by enhancing contrast, and make video look closer to real scenes [2].

Human eyes are very sensitivity and can find the light variation in fraction of seconds. Human eyes have color adaptive ability to recognize high dynamic range. But the camera has high dynamic range and it is limited by its tone. It is usually occurs that video taken in so dark then details can’t be seen easily. And videos taken by a camera is identical to an image sensed by human eyes. But these images are different in some situations due to the difference between human eyes and a digital camera [3-5]. The dynamic range of human eyes is four to six times as wide as a digital camera. Therefore, these differences especially in situations where strong luminance contrast exists. Hence, the real scene cannot be correlated to digital image. Most video enhancement methods attempt to analyze pixels using surrounding pixels to improve detail visibility [6]. To retain the video detail the bilateral tone adjustment is done in video frames. The idea of bilateral tone adjustment is to treat dark and bright regions separately using two different tones. Bilateral tone adjustment retrieve the details in dark and bright regions and but also boosts the contrast in the mid-tone regions.

II. VIDEO ENHANCEMENT

Some regions of a video catch human visual attention at first glance more than other regions, and the regions are considered more salient method.

A. Framework Overview

Global contrast enhancement is required to reveal hidden details in dark and bright regions. In addition to enhancing regions with extremely high or low luminance, proposed technique is also significantly stretches the contrast in mid-tone regions, which most other curve-based global enhancement methods ignore [7-9].

Figure 1. Flow diagram of proposed video enhancement technique.

Saliency values can be regarded as complex local information indicating the degree of human interest in each pixel in a video. Saliency maps are most frequently used to extract useful objects in the preprocessing of surveillance systems or recognition problems [10]. The saliency maps as a reference for local contrast enhancement and proposes the SWCE method. Fig. 1 illustrates the proposed video enhancement technique. First, the videos are separated in to...
frames. Frames are transformed into the HSV domain to derive the luminance and color maps. Then, Bilateral tone adjustment is applied to the luminance map while the saliency detector calculates the saliency map[11]. Basically all kinds of saliency detection methods can be used for saliency map generation. This adopts color saliency detection method because it produces a satisfactory saliency map. SWCE is then performed based on the adjusted luminance and saliency map. Finally, the output image is the inverse HSV transform of the enhanced luminance map with the original color maps [12].

B. Saliency-Weighted Contrast Enhancement

Due to the Bilateral tone adjustment, we do not need to gather and analyze global luminance information in this post-process of contrast enhancement. The SWCE is designed to produce high contrast in regions with higher extent of human interests. In addition, the noise is not over-enhanced because SWCE controls the enhancement extent adaptively depending on local saliency values. The proposed method reveals the details contained in dark regions, and the enhancement result is quite smooth and natural [13]. The SWCE is designed to produce high contrast in regions with higher extent of human interests. In addition, the noise is not over-enhanced because SWCE controls the enhancement extent adaptively depending on local saliency values. The proposed method reveals the details contained in dark regions, and the enhancement result is quite smooth and natural.

C. Metrics

The quality of an image is examined by objective evaluation as well as subjective evaluation. For subjective evaluation, the image has to be observed by a human expert. But the human visual system is so complicated and this cannot give the exact quality of image. There are various metrics used for objective evaluation of an image. Some of them are mean square error (MSE), root mean squared error (RMSE), mean absolute error (MAE) and peak signal to noise ratio (PSNR).

1) Mean Square Error

Mean Square Error (MSE) is given as

$$MSE = \sum_{i=1}^{m} \sum_{j=1}^{n} (A(m,n) - A(m,n))^2$$

Mean Absolute Error is defined as

$$MAE = \sum_{i=1}^{m} \sum_{j=1}^{n} |A(m,n) - A(m,n)|$$

2) Peak Signal to Noise Ratio

Peak signal to noise ratio (PSNR) is defined in logarithmic scale in db. It is a ratio of peak signal power to noise power. Since the MSE represents the noise power and the peak signal power, the PSNR is defined as

$$PSNR = 10 \times \log_{10}(1/MSE)$$

III. SIMULATION RESULTS

To enhance the better quality of a video the bilateral tone adjustment technique is used here. In addition, noise estimation is taken into account to quantify the artifacts of noise generation during contrast enhancement process. The video sequence is separated into frames to yield a single high quality image.

![Original Noisy Frames](image1)

![Enhanced Frames](image2)

Figure 2. Shows original noisy frames and the results of the Proposed Techniques for gray scale video.
The image captured by all devices undergoes filtering by smoothing filters. All recording devices, both analogue and digital, have attributes which make them susceptible to noise. The fundamental problem of image processing is to reduce noise from a digital color image.

Fig. 2. (a) (c) & (e) Shows the original input gray scale video frames and in Fig. 2. (b) (d) & (f) shows the output enhanced gray scale video frames.  Fig. 3 (a) (c) (e) & (g) shows the color noisy frame taken from the indoor cctv and enhanced video is shown in Fig. 3. (b) (d) (f) & (h). In Fig. 4. (a) (c) (e) & (g) shows the color noisy frame taken from the outdoor surveillance camera and Fig. 4. (b) (d) (f) & (h) shows the enhanced video.
The proposed SWCE has the highest performance among all other contrast enhancement algorithms, showing that SWCE can perform enhancement selectively in the salient region which contains less noise.

The enhanced frame has significantly higher signal to noise ratio (SNR) relative to the original frames of both gray scale and color videos.

IV. CONCLUSION

This proposed video enhancement framework consisting of Bilateral Tone adjustment and SWCE. SWCE method integrates the saliency map with a simple contrast enhancement, and also performs more enhancements in regions that humans give more attention. This work showed that SWCE achieves greater performance using luminance component. To evaluate the enhancement performance, the PSNR value was used to measure the quality of enhancement. This technique will also prove that enhancing the quality of low-grade video surveillance cameras.

REFERENCES


