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To Achieve High Quality Perception Based on Multi Scale Retinex Algorithm using PCCE Mechanism for OLED Devices

Dr. B. R. VIKRAM Ph.D, Professor,Principal [1]

EMPALA SUVARNA M.Tech [2]

Vijay Rural Engineering College, Nizamabad, Telangana, 503003, INDIA [1] [2]

[1]vikramom2007@gmail.com [2]suvarnaempala@gmail.com

Abstract

The power constrained contrast enhancement algorithm is used for emissive displays and it is based on histogram equalization. However, with HE-based contrast enhancement there is an inherent risk of overstretching. To avoid this we presents a high equipped power constrained algorithm for OLEDs based on multi scale retinex. MSR plays main role in the proposed algorithm and it is based on of power controllable log operation fallowed by sub band wise gain control. The MSR is used for power reduction in display of images, the same approach can be used for high definition videos, and the algorithm provides enhanced video sequence, better perceptual video quality and power consistent ratio without flickering artifacts. This proposed algorithm gives the better visual quality than previous existed power constrained contrast enhancement algorithm for videos.

Keywords: PCCE, multi scale retinex, OLED, power consumption.

1. INTRODUCTION

Current showcase boards can be ordered into emissive and non-emissive showcases. The cathodebeam tube (CRT), the plasma presentation board (PDP) and the natural light radiating diode (OLED) are illustrative emissive presentations that don't oblige outside light sources, though the dainty film transistor fluid precious stone showcase (TFT-LCD) is non-emissive. When all is said in done, emissive showcases have a few preferences over non-emissive ones. To begin with, since an emissive presentation can kill singular pixels, it can express finish obscurity and accomplish a high difference proportion. Second, emissive showcases devour less power than non-emissive ones on the grounds that every pixel in an emissive presentation can be autonomously determined and the force utilization of the pixel is relative to its force level. Note that non-emissive showcases ought to turn on their backdrop illumination paying little mind to pixel power.

Therefore, the OLED is viewed as the most guaranteeing possibility for the cutting edge show, which will supplant the TFT-LCD shows as of now ruling the business market. Despite the fact that the OLED is chiefly utilized for little boards as a part of cell phones, its large scale manufacturing innovation is being produced quickly. So expansive size OLED boards might soon be embraced in a more extensive scope of gadgets, for example, highdefinition TV

(HDTV) and ultra HDTV. Note that show modules devour the vast majority of the force in advanced media gadgets. So methods to minimize power utilization in the presentation are unavoidably needed. A few picture handling procedures for force sparing in showcase boards have been proposed, past circuit-level force funds. Tragically, such procedures concentrate on decreasing backdrop illumination force for TFT-LCDs while saving the same level of saw quality.

Retinex hypothesis accept that the human visual construction has three autonomous approaches to see short, medium, and long wavelengths in the obvious light series. Using retinex hypothesis, SSR uses Gaussian low pass channel (LPF) and log function to highlight a exact wavelength extent of the picture, and MSR gives a give way picture as the weighted aggregate of the retinex yield pictures by utilizing a few direct support regions. This paper presents a algorithm of contrast enhancement of power-constrained using a sub-band decomposed MSR (SD-MSR) for OLED display. First, a modified log function for dynamic power saving is used. Then a coarse-to-fine power control mechanis m based on SD-MSR is used. This SDMSR simultaneously gain contrast development and dynamic range compression using a changed weighting method proper for an input image. Experimental results are shown to compare with the existing systems.

II. BACKGROUND

2.1. MULTISCALE RETINEX

In common, MSR, which is used as the key factor of them proposed algorithm, consists of power controllable log function and sub band wise gain control. Decomposition of an input image to MSRs of different sub-bands, and a proper gain for each MSR is calculated. Then coarse-to-fine power control mechanism is carried out. This step repeats until the target power saving is obtained and it jointly achieves contrast enhancement and dynamic range compression using an adaptive weighting strategy proper for an input image.

2.2. OLED DISPLAY

Organic light emitting diode (OLED) is an emerging visual technology, it provides much wider view picture and high image quality compare to conventional LCDs. The main difference between power characteristics in an OLED display and LCD is that OLED displays do not require external lighting power because its pixels are emissive once, and each pixel in an OLED display consists of three components for red, green and blue components respectively. Moreover, these components of a pixel have different luminance efficiencies. According to the result, the pixel color directly impact on its power consumption.

OLED displays and liquid crystal displays have a very similar organization, including a group of addressable pixels, LCD or OLED, control circuitry that generates the control and data signals for the panel based on display content, and interface to the graphics processing unit. In this paper, we address the power consumption of the display and focus on the variance in power consumption introduced by the OLED panel when showing different content. Our power model take input from different places of the system and can be implemented.

2.3. CONTRAST ENHANCEMENT

Contrast is the difference in visual properties that makes an object (or its representation in an image) distinguishable from other objects and the background. In visual perception of the real world, contrast is determined by the difference in the color and brightness of the object and other objects within the same field of view. In other words, it is the different between the darker and the lighter pixel of the image, if it is big the image will have high contrast and in the other case the image will have low contrast.

Figure 1: On the left half low contrast, and on the right half high contrast image

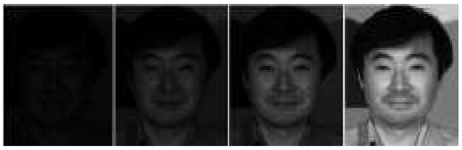


Figure 2: contrast enhancement images

3. PROPOSED METHOD

3.1 Sub-Band decomposed multi-Scale retinex

MSR is an extended SSR with multiple kernel windows of different sizes. MSR output is a weighted sum of several different SSR outputs . The MSR output for a single spectral component can be represented as

$$R^{MSR}(x,y) = \sum_{n=1}^{N} w_n . R_n(x,y) \qquad (1)$$

where

$$R_n(x,y) = logI(x,y) - \log\big(F_n(x,y) * I(x,y)\big) \qquad (2)$$

Here $R_n(x,y)$,denotes a retinex output associated with the n-the scale for an input image $I(x,y)$.Note that gain wn is determined so that it can satisfy the condition of $\sum w_n = 1$. The symbol "*" in Eq. (2) denotes the convolution operation and Nis the number of scales. $F_n(x,y)$ Denotes a surround function and is given by

$$F_n(x,y) = K_n e^{(x^2+y^2)}/\sigma_n^2$$

(3)

Where K_n is determined so that $F_n(x,y)$ can satisfy $\sum\sum F_n(x,y) = 1$. σ_n^2 denotes the variance of the Gaussian kernel at then-the sub-band. Under the condition $\sigma_n > \sigma_{n-1}$ every SSR, we can derive successive frequency sub-bands. Note that a small is suitable for enhancing fine details, whereas a Largent is suitable for improving tonality. Thus, it is important to select an appropriate value of an in the MSR. Based on this rationale, Jang et al. proposed an SD-MSR that consists of a modified logarithmic function, sub-band decomposition, space varying sub-band gain, and an automatic gain/offset control [16] (see Fig. 1). The modified log (mlog) is defined as

$$mlog\big(I(x,y)\big) = \begin{cases} w_L \log\big(I(x,y)+1\big) & I(x,y) \le \tau \\ -w_H \log\big(D - I(x,y)\big) + logD) & I(x,y) > \tau \end{cases} \qquad (4)$$

Where τ is a user-defined threshold and D denotes an image dynamic range. For example, D is 256 for an 8-bit image

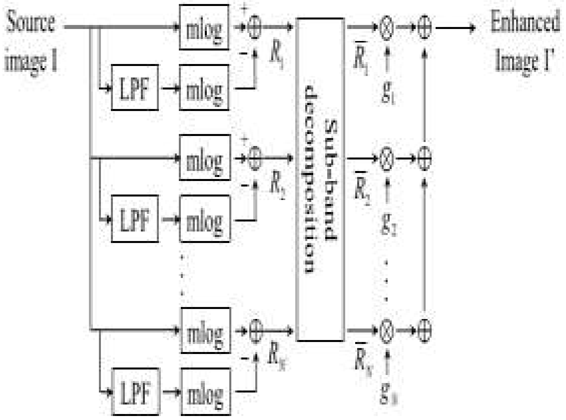


Figure 3: Block diagram of the conventional SD-MSR

w_L And w_L denote weighting parameters according to and are defined as

$$w_L = \frac{\frac{\tau}{D-1}logD}{\log(\tau+1)},\ w_L = \frac{(1-\frac{\tau}{D-1})logD}{\log(D-1)} \qquad (5)$$

s a result, the mlog function of Eq. (4) enhances the contrasts of dark regions as well as bright regions. In this way, we can enhance image details both in highlights and shadows. Another feature of SD-MSR is to decompose the modified retinex outputs into nearly non-overlapping spectral bands. The following equation accomplishes this sub-band decomposition:

$$\bar{R}_1 = R_1 \qquad n = 1$$

$$\bar{R}_n = R_n - R_{n-1} \qquad 2 \le n < N \qquad (6)$$

As n increases, Rn corresponds to the low frequency region n more and more. Here, Rn is computed by replacing the log of Eq. (2) With the mlog of Eq. (4) Next, the space vary in g sub-band gain at then-the sub-band is defined as

$$g_n(x,y) = \left(\frac{1}{NR_n(x,y)+\varepsilon_g}\right)^{1-\frac{\sigma_n}{\sigma max_{+\varepsilon\sigma}}} \qquad (7)$$

Where

$$\sigma_{max} = \max_{n\epsilon[1,2,3\ldots N]} \sigma_n$$

$$NR_n(x,y) = \frac{|\bar{R}_n(x,y)|}{\bar{R}_{n_{max}}} \qquad (8)$$

In a high spectral band of small, they make the gain difference between pixels larger, especially for the pixels with low $NR_n(x,y)$. This is because this spectral band has large high-frequency components representing image details. Meanwhile, they lower the gain difference between pixels in a high spectral band of large n to maintain the characteristics of a natural scene. Thus, using Eq. (7), the final enhanced imageIis output as follows

$$I' = \sum_{n=1}^{N} g_n \widetilde{R_n} \qquad (9)$$

3.2 The Proposed Algorithm

We propose a power governable distinction enhancement algorithm for OLED show primarily based on SD-MSR. Fig. 2 describe the projected formula that consists of three stages. the primary stage coarsely reduces the facility of Associate in Nursing input image nearer to the target power with distinction improvement, and the second stage finely controls the image power such that it's terribly near the target power. If the input could be a video sequence, the ultimate stage adjusts the facility of every image so that it is like those of its neighbors by considering the temporal coherence of the input video sequence. The projected formula is differentiated from previous methods in the following 3 aspects. First, we tend to control the target power level mechanically. Second, we tend to avoid theflickering development by keeping the facility levels of adjacent images constant for video sequences. Third, we tend to come through time period process of the projected formula on a all-purpose graphics process unit (GPU) even for full HD video sequences

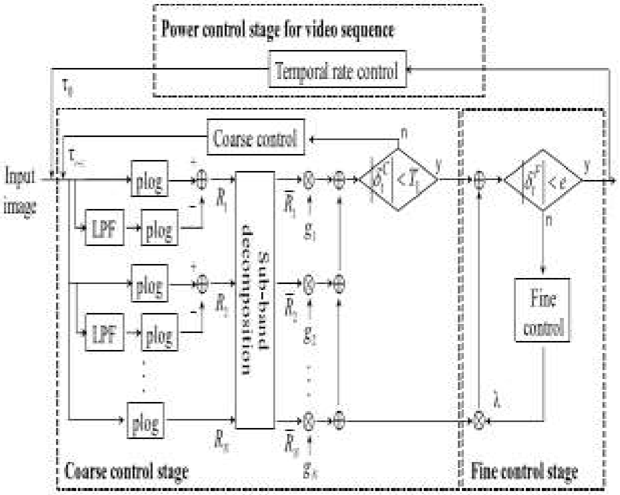


Figure 4: Block diagram of proposed method

Image nearer to the target power with distinction improvement and the second stage finely controls the image power such that it's terribly near the target power. If the input may be a video sequence, the ultimate stage adjusts the ability of every image so that it's the same as those of its neighbors by considering the temporal coherence of the input video sequence. The projected algorithmic program is differentiated from previous methods within the following 3 aspects. First, we have a tendency to control the target power level mechanically. Second, we have a tendency to avoid the flickering development by keeping the ability levels of adjacent images constant for video sequences. Third, we have a tendency to bring home the bacon real-time process of the projected algorithmic program on a general purpose graphics process unit (GPU) even for full HD video sequences.

A. Power Modeling in OLED Display

Before presenting an in depth clarification of the projected algorithmic program, we want to model power for associate OLED show. Dong et al. conferred a pel-based power model that estimates the ability consumption of OLED modules supported the red green-blue (RGB) specification of every pixel [21]. the ability consumption of associate OLED show with K pixels, i.e., P is

$$P_{OLED} = C + \sum_{i=1}^{K}(f_R(R_i) + f_G(G_i)+f_B(B_i)) \quad (10)$$

Also, we consider only the Y-componentbecause it dominates the entire overall power. Note that theY-component indicates the luminance component in YUVcolor format. So we use the Y-component power consumption(YP) of an OLED display with Kpixels [11] as

$$Y_P = \sum_{i=1}^{K} Y_i^{\gamma} \quad (11)$$

Where γ is a parameter for gamma correction for a given display device

B. The Proposed Algorithm

This section details the proposed algorithm.1) Coarse Control Stage: The mlog of conventional SD-MSR plays a role in enhancing the contrasts of highlights and shadow regions. In other words, contrast in the dark region becomes high by increasing the intensity level of the pixels in the region, and contrast in the bright region also becomes high by decreasing the intensity level of the pixels in the region. However, the increase of the intensity values in the shadow region results in the increase in power consumption for the OLED display. So, for low power consumption as well as contrast enhancement, even in the shadow region, we redefine a so-called power-constrained log (plog) from them log of Eq. (4) as follows

$$plog\left(I(x,y)\right) = \begin{cases} \frac{\tau log D log(\alpha I(x,y)+1)}{(D-1)\log(\alpha\tau+1)} & I(x,y) \leq \tau \\ mlog\left(I(x,y)\right) & I(x,y) > \tau \end{cases} \tag{12}$$

Therefore, the $plog$ of Eq. (12) has the effect of controlling the increase in power consumption while partially lowering the contrast in the dark region. From Eq. (7) and MSRs computed by $plog$, i.e., {Rn}, we can derive the following output image

$$\tilde{R}_t = \sum_{n=1}^{N} g_n \grave{R}_n \tag{13}$$

On the other hand, basin YP on Eq. (11), the power reduction ratio of an input image and its output image is defined as follows

$$p_t = 1 - \frac{YP(\hat{\hat{R}}_t)}{YP(I)} \tag{14}$$

In this paper, $\bar{R}_n$ can be computed with Eq. (15) as in [16].

$$f(X) = X^N = \frac{X-m}{M-m}(L-1)+l \tag{15}$$

Let δ_t denote the difference between p_t and P as in Eq. (16)

$$\delta_t = P - p_t \tag{16}$$

Eq. (17) because such a condition indicates an excess of power reduction over P.

$$\tau_{t+1} = \tau_t + {}^{(D-\tau_t)}/_{2} \tag{17}$$

we increase τ relatively small as in Eq. (18) because δCt weakly over runs P

$$\tau_{t+1} = \tau_t + {}^{(D-\tau_t)}/_{4} \tag{18}$$

So we approach P by decreasing τ relatively small as in Eq. (19).

$$\tau_{t+1} = \tau_t + {}^{\tau_t}/_{4} \tag{19}$$

So we rapidly approach P by decreasing τ significantly.

$$\tau_{t+1} = \tau_t + {}^{\tau_t}/_{2} \tag{20}$$

On the other hand, the low-frequency region is rarely related to image details, but it dominates image power as a whole. So we try to approach P by finely controlling the proportion of the lowest-band MSR which may have most of the image power. In detail, we control the gain of RN as follows:

$$R^{\wedge} = \sum_{n=1}^{N-1} g_n \bar{R}_n + (g_N + \lambda)\bar{R}_N \tag{21}$$

Where λ indicates a control parameter for the lowest-band MSRλ, which is updated according to Eq. (22) enables the FCS to approach the target power with little change of contrast

$$\lambda_{t+1} = \lambda_t - \delta_t^F \qquad (22)$$

4. SIMULATION RESULTS

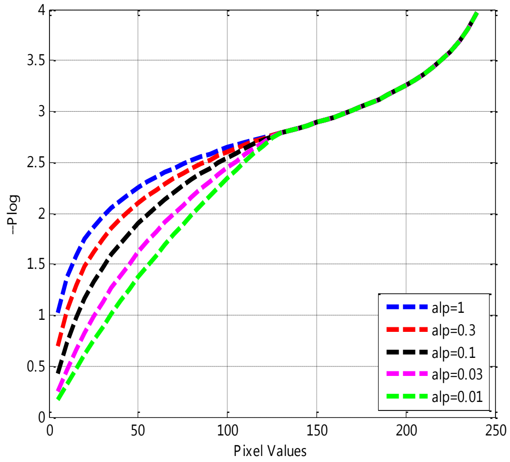


Figure 5: Coarse control stage

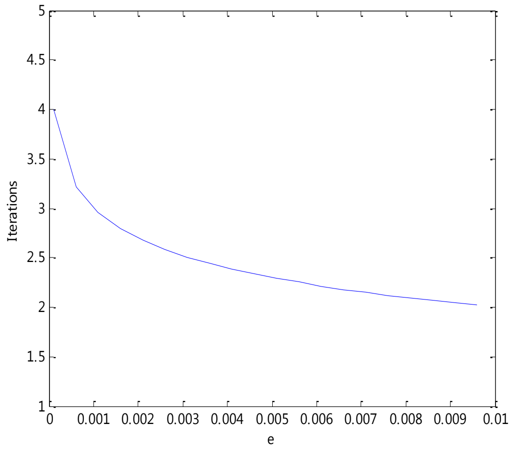


Figure 6: Fine control stage (Iterations)

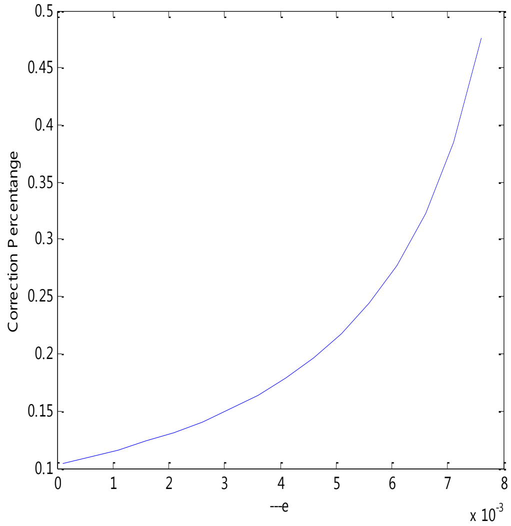
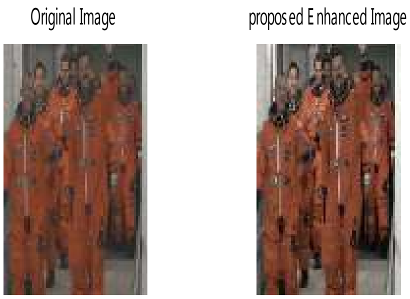
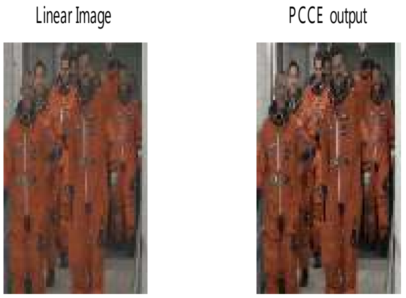


Figure 7: Fine control stage (Correction percentage)



Original Image

proposed Enhanced Image

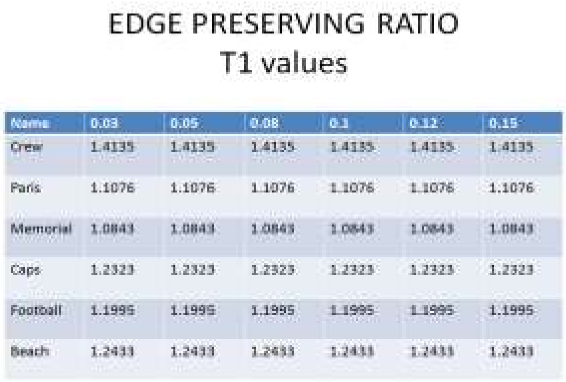


Linear Image

PCCE output

Figure 8: (a) Original image (b) Proposed enhanced image (c) Linear image (d) PCCE output

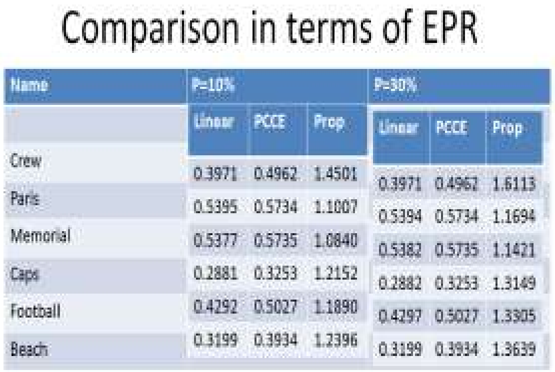
Table 1: Edge preserving ratio



EDGE PRESERVING RATIO
T1 values

Name	0.03	0.05	0.08	0.1	0.12	0.15
Crew	1.4135	1.4135	1.4135	1.4135	1.4135	1.4135
Paris	1.1076	1.1076	1.1076	1.1076	1.1076	1.1076
Memorial	1.0843	1.0843	1.0843	1.0843	1.0843	1.0843
Caps	1.2323	1.2323	1.2323	1.2323	1.2323	1.2323
Football	1.1995	1.1995	1.1995	1.1995	1.1995	1.1995
Beach	1.2433	1.2433	1.2433	1.2433	1.2433	1.2433

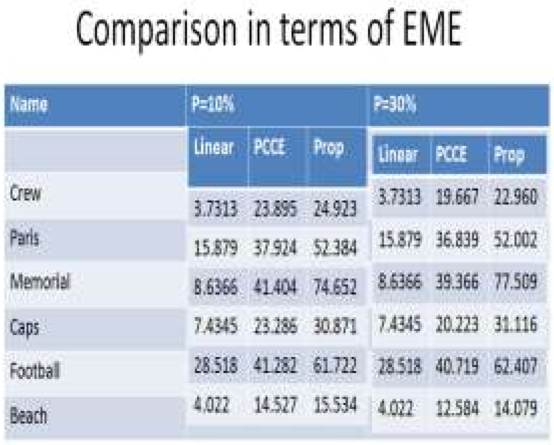
Table 2: Comparison in terms of EPR



Comparison in terms of EPR

Name	P=10%			P=30%		
	Linear	PCCE	Prop	Linear	PCCE	Prop
Crew	0.3971	0.4962	1.4501	0.3971	0.4962	1.6113
Paris	0.5395	0.5734	1.1007	0.5394	0.5734	1.1694
Memorial	0.5377	0.5735	1.0840	0.5382	0.5735	1.1421
Caps	0.2881	0.3253	1.2152	0.2882	0.3253	1.3149
Football	0.4292	0.5027	1.1890	0.4297	0.5027	1.3305
Beach	0.3199	0.3934	1.2396	0.3199	0.3934	1.3639

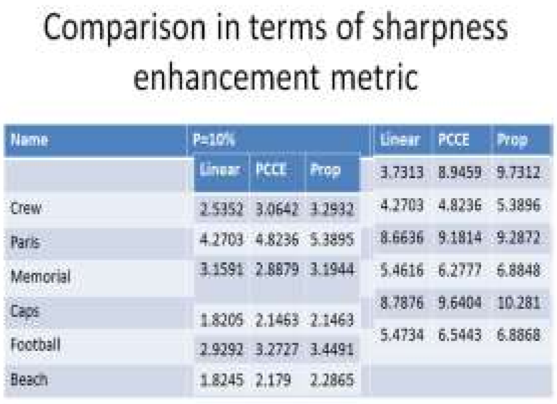
Table 3: Comparison in terms of EMR



Comparison in terms of EME

Name	P=10%			P=30%		
	Linear	PCCE	Prop	Linear	PCCE	Prop
Crew	3.7313	23.895	24.923	3.7313	19.667	22.960
Paris	15.879	37.924	52.384	15.879	36.839	52.002
Memorial	8.6366	41.404	74.652	8.6366	39.366	77.509
Caps	7.4345	23.286	30.871	7.4345	20.223	31.116
Football	28.518	41.282	61.722	28.518	40.719	62.407
Beach	4.022	14.527	15.534	4.022	12.584	14.079

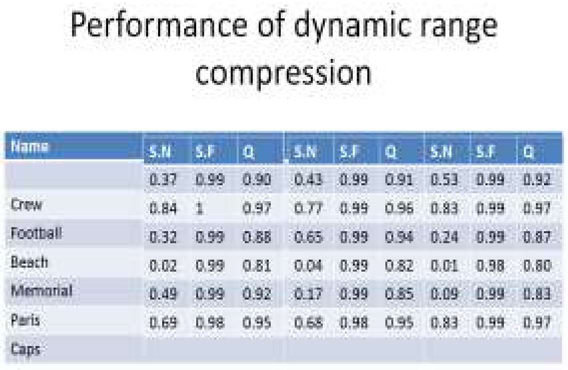
Table 4: Comparison in terms of sharpness enhancement metric



Comparison in terms of sharpness enhancement metric

Name	P=10%			Linear	PCCE	Prop
	Linear	PCCE	Prop	3.7313	8.9459	9.7312
Crew	2.5352	3.0642	3.2932	4.2703	4.8236	5.3896
Paris	4.2703	4.8236	5.3895	8.6636	9.1814	9.2872
Memorial	3.1591	2.8879	3.1944	5.4616	6.2777	6.8848
Caps	1.8205	2.1463	2.1463	8.7876	9.6404	10.281
Football	2.9292	3.2727	3.4491	5.4734	6.5443	6.8868
Beach	1.8245	2.179	2.2865			

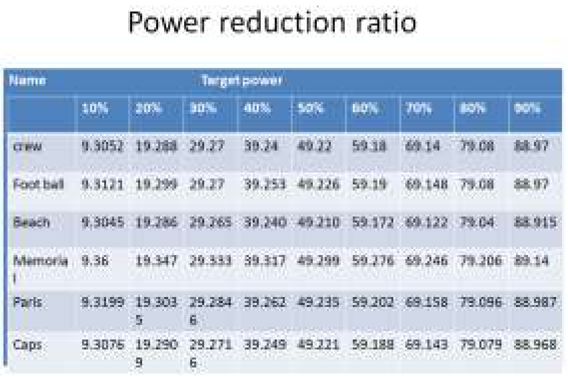
Table 5: Comparison in terms of dynamic range compression



Performance of dynamic range compression

Name	S.N	S.F	Q	S.N	S.F	Q	S.N	S.F	Q
	0.37	0.99	0.90	0.43	0.99	0.91	0.53	0.99	0.92
Crew	0.84	1	0.97	0.77	0.99	0.96	0.83	0.99	0.97
Football	0.32	0.99	0.88	0.65	0.99	0.94	0.24	0.99	0.87
Beach	0.02	0.99	0.81	0.04	0.99	0.82	0.01	0.98	0.80
Memorial	0.49	0.99	0.92	0.17	0.99	0.85	0.09	0.99	0.83
Paris	0.69	0.98	0.95	0.68	0.98	0.95	0.83	0.99	0.97
Caps									

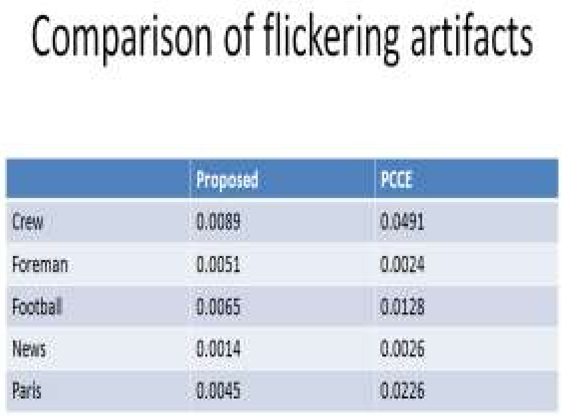
Table 6: power reduction ratio



Power reduction ratio

Name	Target power								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
crew	9.3052	19.288	29.27	39.24	49.22	59.18	69.14	79.08	88.97
Foot ball	9.3121	19.299	29.27	39.253	49.226	59.19	69.148	79.08	88.97
Beach	9.3045	19.286	29.265	39.240	49.210	59.172	69.122	79.04	88.915
Memoria l	9.36	19.347	29.333	39.317	49.299	59.276	69.246	79.206	89.14
Paris	9.3199	19.303 5	29.284 6	39.262	49.235	59.202	69.158	79.096	88.987
Caps	9.3076	19.290 9	29.271 6	39.249	49.221	59.188	69.143	79.079	88.968

Table 7: Comparison of flickering artifacts



Comparison of flickering artifacts

	Proposed	PCCE
Crew	0.0089	0.0491
Foreman	0.0051	0.0024
Football	0.0065	0.0128
News	0.0014	0.0026
Paris	0.0045	0.0226

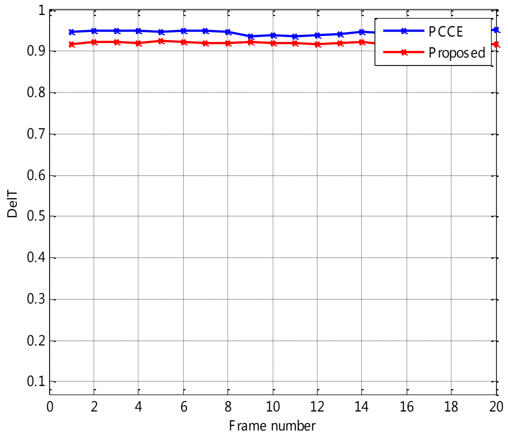


Figure 9: PRR for foremen

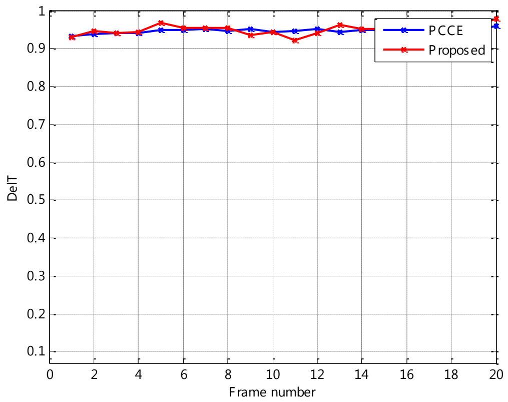


Figure 10: PRR comparison for football video

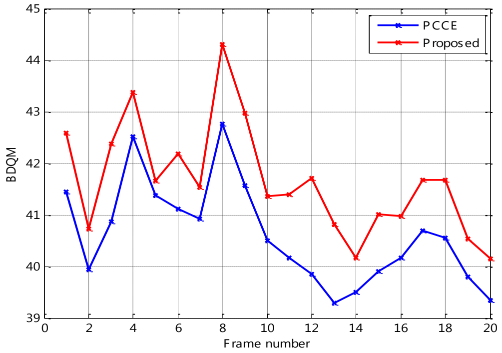


Figure 11: Extension (BDQM)

Advantages: The different manufacturing process of OLEDs lends itself to several advantages over flat panel displays made with LCD technology

5. CONCLUSION

This paper proposes Associate in Nursing SD-MSRbased image processing algorithm for fine power management in OLED displays. We designed a power-constrained log perform for effective power saving in dark regions. victimization the powerconstrained log function for SD-MSR Associate in Nursing Associate in Nursing adjective weight strategy proper for an input image, we tend to projected a coarse-to-fine power control mechanism for still pictures. Finally, we tend to given a power management theme for a constant power reduction ratio in video sequences by victimization temporal coherence in video sequences. Experimental results showed that the proposed algorithm provides higher visual quality than previous works, and a consistent power-saving magnitude relation while not the Specifically, the proposed algorithm provides at most twelve months and on average13% higher edge-preserving ratios than the state-of-the-art algorithm (i.e., PCCE [11]). In addition, we tend to tried the possibility of real-time operation by accomplishing Associate in nursing entire execution time of nine ms per 1080p image.

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