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An Efficient Power-Constrained Contrast Enhancement Algorithm for OLED Displays Using Multi Scale Retinex Algorithm

A. Prem Kumar reddy[1] K. Prushotham Prasad[2]

Department of ECE (DECS) [1], Assistant professorM.tech[2]

Siddhartha educational academy group of institutions, Tirupathi, Andhra Pradesh, INDIA

Abstract

A Novel calculation for imperativeness obliged differentiation upgrade Algorithm utilizing SDMSR was propose . As a rule, MSR, which is the key segment of the proposed calculation, comprises of force controllable log operation and sub band wise increase control. To start with, we decay an info picture to MSRs of distinctive sub-groups, and figure a fitting addition for every MSR. Second, we apply a coarse-to-fine power control system, which recomputes the MSRs and additions. This step emphasizes until the target force sparing is precisely fulfilled. With feature successions, the differentiation levels of adjoining pictures are resolved reliably utilizing fleeting soundness as a part of request to abstain from glinting antiquities. At long last, we display a few improvement aptitudes for ongoing preparing. Test results demonstrate that the proposed calculation gives preferable visual quality over past techniques and a steady power-sparing degree without glimmering ancient rarities, actually for feature arrangements.

KEYWORDS: Power consumption, contrast enhancement, OLED, multi-scale retinex

1. INTRODUCTION

Current showcase boards can be ordered into emissive and non-emissive showcases. The cathode beam 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. 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. So they can't be connected to power sparing in emissive showcase gadgets, for example, OLED. Lee et al. proposed a force obliged difference improvement calculation (PCCE) for emissive presentations in light of histogram leveling (HE). They built up a force utilization model for OLED shows and figured a target work that comprises of the HE term and the force term. By minimizing the target capacity in view of the arched advancement hypothesis, they attempted to all the while accomplish contrast upgrade and force funds. Be that as it may, with HE -based complexity upgrade there is a characteristic danger of overstretching.

Additionally, since their system relies on upon specific parameters it can't consequently, reliably and precisely give the force sparing level craved by a client. Then again, different difference improvement procedures have been produced for many years. As one of them retinex is a remarkable non-straight improvement technique utilized for differentiation upgrade and in addition element range pressure. The retinex hypothesis was proposed via Land and McCann, and Jobson et al. adjusted their hypothesis to single scale retinex (SSR) and multi-scale retinex (MSR). Retinex hypothesis accept that the human visual framework has three autonomous approaches to see short, medium, and long wavelengths in the obvious light range. In light of the retinex hypothesis, SSR uses Gaussian low pass channel (LPF) and log operation to highlight a particular wavelength scope of the picture, and MSR gives a yield picture as the weighted aggregate of the retinex yield pictures by utilizing a few direct LPFs having diverse bolster loca.

2. BACKGROUND

Organic optoelectronic devices like organic resonant tunneling diode, organic light emitting diodes, organic phototransistors, organic photovoltaic cells and organic photo detector have played an important role in the domain of chemistry, physics and all other fields. The optoelectronic engineering is to recreate conventional lighting sources like incandescent and fluorescent lighting with much power efficient semiconducting light sources. Organic light emitting diodes have many advantages such as self renewability, less fire risk, ease of fabrication and low power consumption etc. OLEDs have become very promising of replacing liquid crystal diodes (LCDs) and other lighting devices due to their low cost, brightness, high speed and contrast. OLEDs have been divided into two parts where one is made of small organic molecules and the other is made of organic polymers. Due to its remarkable properties like light weight, flexibility, transparent and color tune ability, OLEDs becomes an ideal modern light source. It emits light when stimulated emission gets possible by electricity. OLED displays consists of organic electroluminescence (made by small molecules or polymers).The first electroluminescence was observed in 1950s when acridine orange and quinacrine were subjected to high voltage alternating current. This observation shows that electroluminescence devices which depend on organic materials are of great interest. It is 100 to 500 nm thick and a solid state semiconductor device which consists of a conducting layer and an emissive layer. These two layers are implanted between two electrodes and deposited on substrate. The conducting layer is made of organic plastic molecules which transport holes from the anode.

The emissive layer is a film of organic compound which transport electrons from the cathode and emits light when electric current is applied. OLEDs are double charged injection devices which require the simultaneous supply of electrons and holes to the electroluminescent materials [Figure 1]

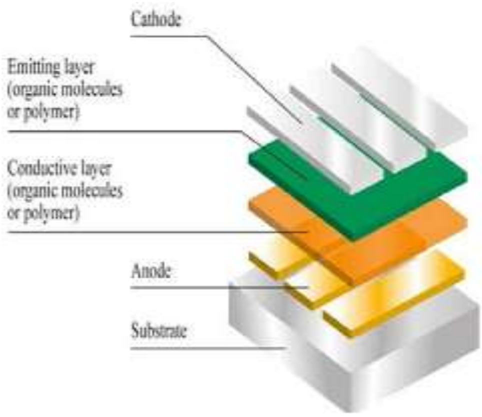

Figure 1: Fundamental structure of OLED

In two layers based OLED, at the electrode-organic layer interface, electrons are injected from the cathode in the conduction band (LUMO) of the organic compound and, holes are injected from the anode in the valance band (HOMO) of the organic compound. In three layers based OLED, the conductive layer is replaced by an electron transport layer (ETL) and a hole transport layer (HTL).When a very high positive electrical potential is applied to the anode with respect to cathode, injection of holes is possible from the anode into the HOMO of HTL, while electrons are injected from the cathode into LUMO of ETL.

In the organic emissive layer (EML) when electrons and holes are spatially close on the same molecules, a percent of them recombine and form an exciton (a bound state of the electron and hole), which is a localized electron hole pair having an excited energy state. In some cases, the exciton may be seen on exciplex (excited complex) .Non radiative mechanisms, like thermal relaxation, may also be possible, but are generally considered undesirable. In the case of recombination energy is emitted as light and at least one electrode must be semi transparent to enable a light emission perpendicular to the substrate which gives very bright and less power consumption than the usual LCD and LED.Fig.2 shows basic mechanism in OLED.

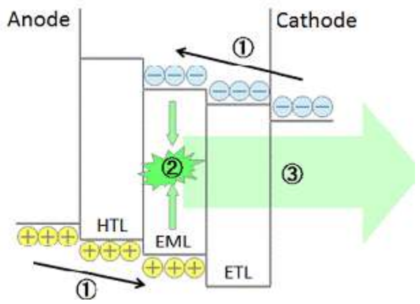

Figure 2: Scheme of the electroluminescence mechanism in an OLED

3. RELATED CONTENT

3.1 Power Consumption

In electrical building, force utilization frequently alludes to the electrical vitality over the long run supplied to work an electrical machine. The vitality utilized by hardware is constantly more than the vitality truly required. This is on the grounds that no hardware is 100% productive. Force is squandered as warmth, vibrations and/or electromagnetic. Power utilization is typically measured in units of kilowatt hours (kWh). All the more precisely, power is the rate of utilization of vitality, measured in watts or pull. Electric vitality utilization is the type of vitality utilization that uses electric vitality. Electric vitality utilization is the real vitality request made on existing power supply. But in Asia and Middle East, utilizations were lessened in all the world locales. In OECD nations, representing 53% of the aggregate, power interest downsized by more than 4.5% in both Europe and North America while it shrank by over 7% in Japan. Power request additionally dropped by more than 4.5% in CIS nations, driven by a substantial cut in Russian utilization. On the other hand, in China and India (22% of the world's utilization), power utilization kept on ascending at an in number pace (+6-7%) to take care of vitality demand identified with high financial development. In Middle East, development rate was diminished however stayed high, just beneath 4%.]

3.2 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 3: On the left half low contrast, and on the right half high contrast image

3.3. OLED

A natural light-emanating diode (OLED) is a light-transmitting diode (LED) in which the emissive electroluminescent layer is a film of natural compound which emanates light because of an electric current. This layer of natural semiconductor is arranged between two terminals; commonly, no less than one of these anodes is straightforward. OLEDs are utilized to make advanced shows in gadgets, for example, TV screens, PC screens, convenient frameworks, for example, cellular telephones, handheld amusement reassures and PDAs. A noteworthy range of examination is the advancement of white OLED gadgets for utilization in strong state lighting applications. There are two principle groups of OLED: those in light of little particles and those utilizing polymers. Adding portable particles to an OLED makes a light-transmitting electrochemical cell (LEC) which has a marginally diverse mode of operation. OLED presentations can utilize either detached matrix (PMOLED) or dynamic network tending to plans. Dynamic framework OLEDs (AMOLED) oblige a dainty film transistor backplane to switch every individual pixel on or off, yet consider higher determination and bigger presentation sizes. An OLED showcase lives up to expectations without a backdrop illumination; therefore, it can show profound dark levels and can be more slender and lighter than a fluid precious stone display (LCD). In low encompassing light conditions, (for example, a dim room), an OLED screen can accomplish a higher complexity proportion than a LCD, paying little mind to whether the LCD uses chilly cathode fluorescent lights or a LED backdrop illumination.

4. SUB-BANDDECOMPOSEDMULTI-SCALERETINEX

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

$$F_n(x,y) = K_n e^{(x^2+y^2)}/\sigma_n^2 \qquad (3)$$

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

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

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

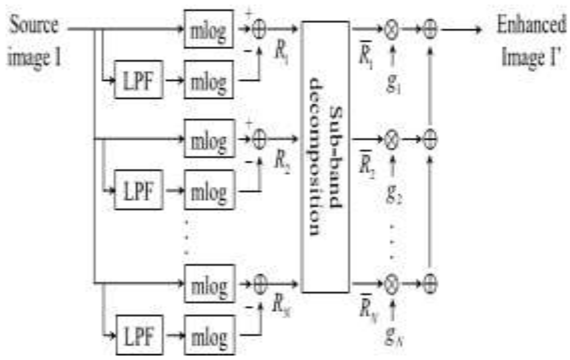

Figure 4: Block diagram of the conventional SD-MSR

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:

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

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

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 image I is output as follows

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

5. PROPOSED METHOD

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

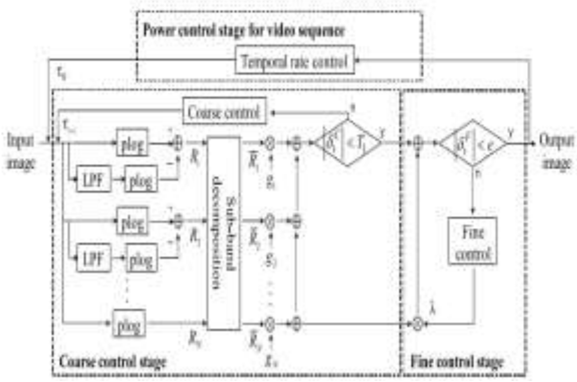

Figure 5: Block diagram of proposed method

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.

5.1. 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

5.2. The Proposed Algorithm flow

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

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

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

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

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

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

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

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

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

$$\delta_t = P - p_t \quad (16)$$

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

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

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

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

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

$$\tau_{t+1} = \tau_t + {\tau_t}/{4} \quad (19)$$

So we rapidly approach P by decreasing τ significantly.

$$\tau_{t+1} = \tau_t + {\tau_t}/{2} \quad (20)$$

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:

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

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

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

6. SIMULATION RESULTS

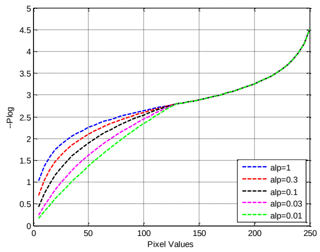

Figure 6: Profile of the proposed algorithm

Figure 7: Output results of the proposed algorithm, Linea algorithm and PCCE algorithm

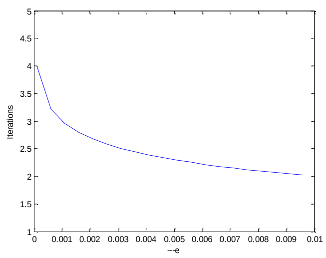

Figure 8: Error analysis w.r.t. no of iterations

7. CONCLUSION

This project proposes an SD-MSR-based image processing algorithm for fine power control in OLED displays. In this designed a power-constrained log function for effective power saving in dark regions. Using the power-constrained log function for SD-MSR and an adaptive weighting strategy proper for an input image, we proposed a coarse-to-fine power control mechanism for still images. Finally, we presented a power control scheme for a constant power reduction ratio in video sequences by using temporal coherence in video sequences. Experimental results showed that the proposed algorithm provides better visual quality than previous works, and a consistent power-saving ratio without the flickering artifact even for video sequences. Specifically, the proposed algorithm provides at maximum 36% and on average 13% higher edge-preserving ratios than the state-of-the-art algorithm (i.e., PCCE [11]). In addition, we proved the possibility of real-time processing by accomplishing an entire execution time of 9 ms per 1080p image.

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