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(71) Applicant: **Thomson Licensing**
92100 Boulogne Billancourt (FR)

(72) Inventors:
- **Weitbruch, Sebastien**
92648, BOULOGNE CEDEX (FR)
- **Cota, Dennis**
92648, BOULOGNE CEDEX (FR)
- **Le Roy, Philippe**
92648, BOULOGNE CEDEX (FR)

(74) Representative: **Le Dantec, Claude**
THOMSON,
European Patent Operations,
46, Quai Alphonse Le Gallo
92100 Boulogne Billancourt (FR)

(54) **Method and apparatus for power level control and/or contrast control of a display device**

(57) The present invention relates to a method and an apparatus for controlling the power level and/or the contrast in a display device having a plurality of luminous elements corresponding to the colour components of the pixels of a picture, wherein the luminance generated by each of said luminous element is based on the intensity of the signal supplied to the luminous element and the power level and/or contrast for each picture is controlled by adjusting the intensity of the signal to be supplied to each luminous element. The invention is applicable to organic light emitting displays (OLED). According to the invention, the intensity of the signal to be supplied to each luminous element is based on reference signals and the adjustment of the signal intensity is made by adjusting the level of the reference signals.

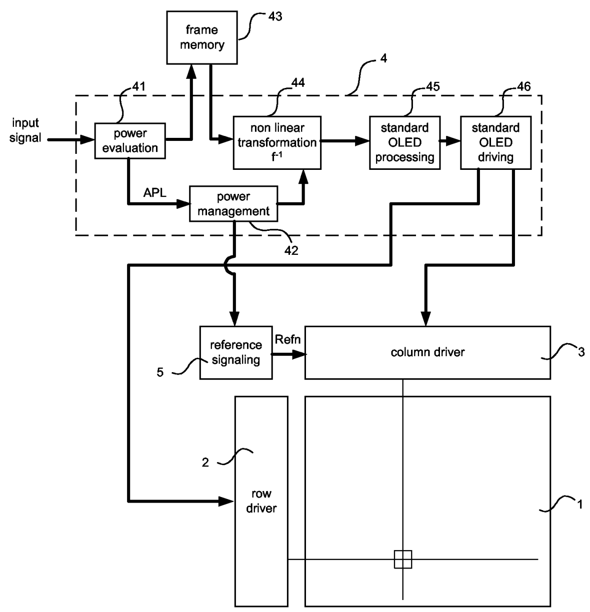

FIGURE 5

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Description

[0001] The present invention relates to a method and an apparatus for controlling the power level and/or the contrast in a display device having a plurality of luminous elements corresponding to the colour components of the pixels of a picture, wherein the luminance generated by each of said luminous element is based on the intensity of the signal supplied to the luminous element.

[0002] More specifically, the invention is closely related to organic light emitting displays (OLED).

Background

[0003] A high peak-white luminance is always required to achieve a good contrast ratio in every display technologies even with ambient light conditions and, for every kind of active displays, more peak white luminance corresponds to a higher power that flows in the electronic of the display. Therefore, if no specific management is done, the enhancement of the peak luminance for a given electronic efficacy will introduce an increase of the power consumption.

[0004] The main idea behind every kind of power management concept associated with peak white enhancement is based on the variation of the peak-luminance depending on the picture content in order to stabilize the power consumption to a specified value. This concept is shown in Figure 1. When the picture load is low, the peak luminance is high and when the picture load is high, the peak luminance is low. The concept described on this figure enables to avoid any overloading of the power supply of the display panel as well as a maximum contrast for a given picture.

[0005] Such a concept suits very well to the human visual system. When the picture load is low, the contrast ratio is high and when the picture is high, the human eye is dazzled and is less sensitive to contrast ratio. So, for a full-white picture, the contrast ratio can be lower than for a peak-white picture.

[0006] In the case of cathode Ray Tubes (CRTs), the power management is based on a so called ABL function (Average Beam-current Limiter), which is implemented by analog means and which decreases video gain as a function of the average luminance of the pictures.

[0007] In the case of an organic light-emitting diode display, also called OLED display, the luminance as well as the power consumption is directly linked to the current that flows through each cell. Currently, there is no power level control means for stabilizing the power consumption to a target value.

[0008] In the other hand, in such a display device, the contrast is adjusted by a video scaler acting on the video signal. If the video signal is coded on 8 bits and if the contrast should be reduced by 50%, the video signal is rescaled leading to a video signal with only a 7 bit resolution. So, there is a loss of video resolution.

Invention

[0009] The present invention proposes a new method and apparatus for controlling the power level and/or the contrast in display devices having a plurality of luminous elements, wherein the luminance generated by each of said luminous element is based on the intensity of the signal supplied to the luminous element and the power level and/or contrast for each picture is controlled by adjusting the intensity of the signal to be supplied to each luminous element.

[0010] The basic idea of this invention is to supply the luminous elements of the display device with a signal whose intensity is based on reference signals and to modify the level of these reference signals for adjusting the intensity of the signals supplied to the luminous elements.

[0011] So, the invention relates to a method for controlling the power level and/or the contrast in a display device having a plurality of luminous elements corresponding to the colour components of the pixels of a picture, wherein the luminance generated by each of said luminous elements is based on the intensity of the signal supplied to the luminous element and the power level and/or contrast for each picture is controlled by adjusting the intensity of the signal to be supplied to each luminous element,

characterized in that the intensity of the signal to be supplied to each luminous element is based on reference signals and in that the adjustment of the signal intensity is made by adjusting the level of the reference signals.

[0012] By this method, the resolution of the video signal supplied to the luminous elements is not modified.

[0013] For controlling the power level, the method further comprises the two following steps :

- calculating, for each picture received by the display device, a parameter representative of the power needed by the display device for displaying said picture; this parameter is for example the average power level; and
- adjusting the intensity of the signal to be supplied to each luminous element in order that the power needed by the display device for displaying said picture is lower than a target value.

[0014] For controlling the contrast of the pictures displayed by the display device, the method further comprises the following steps :

- calculating an adjustment factor to be applied to the intensity of the picture signal supplied to the luminous elements in order that the resulting contrast is equal to a required contrast, and
- applying said adjustment factor to said reference signals.

In a preferred embodiment, a non linear transformation is applied to reference signals, before adjustment of the signal intensity, in order to increase the amplitude of the low-amplitude reference signals. To compensate this transformation, the inverse transformation is applied to the picture signal.

The invention concerns also an apparatus for controlling the power level and/or the contrast in a display device having a plurality of luminous elements corresponding to the colour components of the pixels of a picture, wherein the luminance generated by each of said luminous elements is based on the intensity of the signal supplied to the luminous element and the power level and/or contrast for each picture is controlled by adjusting the intensity of the signal to be supplied to each luminous element,

characterized in that the intensity of the signal to be supplied to each luminous element is based on reference signals and in that it comprises adjustment means for modifying the signal intensity by adjusting the level of the reference signals.

[0015] For controlling the power level, the apparatus further comprises calculation means for calculating, for each picture received by the display device, a parameter representative of the power needed by the display device for displaying said picture, and in that the adjustment means adjusts the level of the reference signals in order that the power needed by the display device for displaying each picture is lower than a target value. The calculation means calculates for example, for each picture received by the display device, the average power level of said picture.

[0016] For controlling the contrast of the pictures displayed by the display device, the apparatus further comprises calculation means for calculating an adjustment factor to be applied to the intensity of the signal supplied to the luminous elements in order that the resulting contrast is equal to a required contrast, and in that the adjustment means applies said adjustment factor to said reference signals.

[0017] For these two applications, the apparatus comprises a frame memory for storing a picture before transmitting it to the display device.

[0018] In a preferred embodiment, the adjustment means of the apparatus comprises means for applying a non linear transformation to reference signals in order to increase the amplitude of the low-amplitude reference signals and the apparatus comprises means for applying the inverse transformation to the picture signal.

[0019] Lastly, the invention concerns also a display device comprising

- a plurality of organic light emitting diodes,
- signal processing means for processing the picture signal received by the display device,
- driving means for driving said plurality of organic light emitting diodes according to the signal processed by the signal processing means,
- reference signalling means for outputting reference signals to the driving means, and
- an apparatus as defined above which is integrated to the signal processing means.

Brief description of the drawings

[0020] Exemplary embodiments of the invention are illustrated in the drawings and in more detail in the following description.

[0021] In the figures :

Fig.1 shows the variation of the peak luminance versus the picture load in a display device ;
Fig.2 shows the structure of the control electronic in a OLED display;
Fig.3 shows the variations of reference voltages according to picture load in a basic embodiment of the invention;
Fig.4 shows the variations of reference voltages according to picture load in an improved embodiment of the invention; and
Fig.5 shows the structure of the control electronic in a OLED display used for implementing the method of the invention;

Description of preferred embodiments

[0022] The invention is described in relation to a OLED display with an active matrix where each luminous element of the display is controlled via an association of several thin-film transistors (TFTs). The general structure of the electronic for controlling the OLED elements is illustrated by figure 2. It comprises :

- an active matrix 1 containing, for each OLED element, an association of several thin-film transistors with a capacitor connected to the OLED material of the luminous element; the capacitor acts as a memory component that stores the value of the luminous element during a certain part of the frame; the thin-film transistors act as switches enabling the selection of the luminous element, the storage of the capacitor and the lighting of the luminous element; in the present structure, the value stored in the capacitor determines the luminance produced by the luminous element;

- at least one row driver 2 that selects line by line the luminous elements of the display in order to refresh their content,
- at least one column driver 3 that delivers the value or content to be stored in each luminous element of the current selected line; this component receives the video information for each luminous element;
- a digital processing and driving unit 4 that applies required video and signal processing steps to the video input signal and that delivers the required signals to the row and column drivers.

[0023] Actually, there are two ways for driving the OLED elements:

- in a current driven concept, the digital video information sent by the digital processing and driving unit 4 is converted by the column driver 3 in a current amplitude that is supplied to the luminous element via the active matrix 1;
- in a voltage driven concept, the digital video information send by the digital processing and driving unit 4 is converted by the column driver 3 in a voltage amplitude that is supplied to the luminous element via the active matrix 1; but, even so, it should be noticed that an OLED element is a current driven so that each voltage based driving unit is based on a voltage to current converter to achieve appropriate lighting.

[0024] The column driver 3 represents, with the digital processing and driving unit 4, the real active part of the electronic and can be considered as a high-level digital to analog converter. The row driver 2 has a quite simple function since it only has to apply a selection line by line. It is more or less a shift register.

[0025] The functioning of said electronic is the following : the input video signal is forwarded to the digital processing and driving unit 4 that delivers, after internal processing, a timing signal for row selection to the row driver 2 synchronized with the data sent to the column driver 3. Depending on the used column driver 3, the data are sent either in a parallel way or in a serial way. Additionally, the column driver 3 is equipped with a reference signaling device 5 for delivering reference signals. More precisely, this device delivers a set of reference voltages in case of voltage driven circuitry or a set of reference currents in case of current driven circuitry, the highest reference being used for the highest gray level (white) and the lowest for the smallest gray level. These reference signals are used by the column driver 3 for generating the signal to be supplied to the OLED element.

[0026] An example of reference signals is given below for a voltage driven circuitry. Eight reference voltages named V_0 to V_7 are used :

$$V0 = 3V$$

$$V1 = 2{,}6V$$

$$V2 = 2{,}2V$$

$$V3 = 1{,}4V$$

$$V4 = 0{,}6V$$

$$V5 = 0{,}3V$$

$$V6 = 0{,}16V$$

$$V7 = 0V$$

[0027] The different gray levels can be defined as given by the following table. The whole table is given by the annex 1.

gray level	gray level voltage	Gray level voltage
0	V7	0.00V
1	V7+(V6-V7)x9/1175	0.001V
2	V7+(V6-V7)x32/1175	0.005V
3	V7+(V6-V7)x76/1175	0.011V
4	V7+(V6-V7)x141/1175	0.02V
5	V7+(V6-V7)x224/1175	0.032V
6	V7+(V6-V7)x321/1175	0.045V
7	V7+(V6-V7)x425/1175	0.06V
8	V7+(V6-V7)x529/1175	0.074V
9	V7+(V6-V7)x630/1175	0.089V
10	V7+(V6-V7)x727/1175	0.102V
11	V7+(V6-V7)x820/1175	0.115V
12	V7+(V6-V7)x910/1175	0.128V
13	V7+(V6-V7)x998/1175	0.14V
14	V7+(V6-V7)x1086/1175	0.153V
15	V6	0.165V
16	V6+(V5-V6)x89/1097	0.176V
...	...	...
252	V1+(V0-V1)x2549/3029	2.937V
253	V1+(V0-V1)x2694/3029	2.956V
254	V1+(V0-V1)x2851/3029	2.977V
255	V0	3.00V

[0028] Of course, these voltage levels are converted into current before being supplied to the OLED elements. For deducing a luminance value from these voltages, it will be assumed in the rest of the present specification that a 3V voltage applied to an OLED element corresponds to a 400cd/m^2 luminance and that it represents the maximal luminance that can be displayed by the screen of the display device. This value is given as an example.

[0029] For a 4/3 screen with a 6.5" (=16.25cm) diagonal (size = 13cm x 9.75cm) and an efficacy for the OLED material around 14Cd/A, the surface of the screen is 13x9.75 = 126.75cm^2 and the current density is 40000/14000 = 2.86mA/cm^2. So, the total current needed by the panel is 126.75x2.86 = 362.1 mA.

[0030] This current value can be considered as too high. For example, it is sought a maximum current value of 80mA.

[0031] According to the invention, the luminance of the display panel is adjusted in order that the current value necessary for displaying the picture is lower than a maximum current value.

[0032] The power of the incoming picture is first evaluated and the luminance of the panel is then adjusted in order to limit the power consumption of the panel to the maximum current value.

[0033] A first step of the inventive method consists in evaluating the power of the incoming picture to decide which luminance should be used for a white level. The computation of the picture power is done by computing the Average Power Level (APL) of the picture through the following function:

$$\mathrm{APL}(\mathrm{I}(x,y)) = \frac{1}{C \times L} \cdot \sum_{x,y} \mathrm{I}(x,y)$$

where I(x,y) represents the video level of the pixel with coordinates x, y in the picture, C is the number of elements columns of the screen and L is the number of elements lines of the screen.

[0034] In the present specification, the APL value of a picture will be expressed as a percentage of white surface in the picture for clarity and simplicity reasons.

[0035] In a second step, the maximal luminance of the screen is determined for different percentages of white surface as shown in the following table. In the case of a maximum current value of 80 mA, the luminance of a full white image (100% white surface) for the above-mentioned 4/3 screen is:

$$80 \cdot \frac{14 \cdot 10^{-3}}{126.75 \cdot 10^{-4}} = 88.363 \text{ cd/m2.}$$

Surface (white)	Luminance (Cd/m2)	Power (mA)
100.00%	88.363 Cd/m2	80.00 mA
97.50%	90.629 Cd/m2	80.00 mA
95.00%	93.014 Cd/m2	80.00 mA
92.50%	95.527 Cd/m2	80.00 mA
90.00%	98.181 Cd/m2	80.00 mA
87.50%	100.986 Cd/m2	80.00 mA
85.00%	103.956 Cd/m2	80.00 mA
82.50%	107.107 Cd/m2	80.00 mA
80.00%	110.454 Cd/m2	80.00 mA
77.50%	114.017 Cd/m2	80.00 mA
75.00%	117.817 Cd/m2	80.00 mA
72.50%	121.88 Cd/m2	80.00 mA
70.00%	126.233 Cd/m2	80.00 mA
67.50%	130.908 Cd/m2	80.00 mA
65.00%	135.943 Cd/m2	80.00 mA
62.50%	141.381 Cd/m2	80.00 mA
60.00%	147.272 Cd/m2	80.00 mA
57.50%	153.675 Cd/m2	80.00 mA
55.00%	160.66 Cd/m2	80.00 mA
52.50%	168.31 Cd/m2	80.00 mA
50.00%	176.726 Cd/m2	80.00 mA
47.50%	186.027 Cd/m2	80.00 mA
45.00%	196.362 Cd/m2	80.00 mA
42.50%	207.913 Cd/m2	80.00 mA
40.00%	220.907 Cd/m2	80.00 mA
37.50%	235.634 Cd/m2	80.00 mA
35.00%	252.465 Cd/m2	80.00 mA
32.50%	271.886 Cd/m2	80.00 mA
30.00%	294.543 Cd/m2	80.00 mA
27.50%	321.32 Cd/m2	80.00 mA

Table continued

Surface (white)	Luminance (Cd/m2)	Power (mA)
25.00%	353.452 Cd/m2	80.00 mA
22.50%	392.724 Cd/m2	80.00 mA
20.00%	400.00 Cd/m2	72.429 mA
17.50%	400.00 Cd/m2	63.375 mA
15.00%	400.00 Cd/m2	54.321 mA
12.50%	400.00 Cd/m2	45.268 mA
10.00%	400.00 Cd/m2	36.214 mA
7.50%	400.00 Cd/m2	27.161 mA
5.00%	400.00 Cd/m2	18.107 mA
2.50%	400.00 Cd/m2	9.054 mA

[0036] As the luminance is in this example limited to 400 cd/m^2, the power consumption for the picture with a white surface percentage inferior to 22 % is inferior to 80 mA. The maximal contrast ratio is obtained for a 22% white surface percentage and is equal to 4.5.

[0037] According to an important characteristics of the invention, the luminance of the screen is adjusted by modifying the value of the reference levels Vn, $n \in [0,...,7]$ defined above. The luminance LUM of the screen can be approximated by a quadratic function of the applied voltage V:

$$LUM(x;y) = 44 \times (V(x;y))^2 .$$

[0038] This formula is given as an example. The following table gives the different voltage values for the reference voltage V0 :

Surface (white)	V0	Luminance (Cd/m2)
100.00%	1.41 V	88.363 Cd/m2
97.50%	1.43 V	90.629 Cd/m2
95.00%	1.45 V	93.014 Cd/m2
92.50%	1.47 V	95.527 Cd/m2
90.00%	1.49 V	98.181 Cd/m2
87.50%	1.51 V	100.986 Cd/m2
85.00%	1.53 V	103.956 Cd/m2
82.50%	1.55 V	107.107 Cd/m2
80.00%	1.58 V	110.454 Cd/m2
77.50%	1.6 V	114.017 Cd/m2
75.00%	1.63 V	117.817 Cd/m2
72.50%	1.66 V	121.88 Cd/m2
70.00%	1.69 V	126.233 Cd/m2
67.50%	1.72 V	130.908 Cd/m2
65.00%	1.75 V	135.943 Cd/m2
62.50%	1.78 V	141.381 Cd/m2
60.00%	1.82 V	147.272 Cd/m2

Table continued

Surface (white)	V0	Luminance (Cd/m2)
57.50%	1.86 V	153.675 Cd/m2
55.00%	1.9 V	160.66 Cd/m2
52.50%	1.95 V	168.31 Cd/m2
50.00%	2.0 V	176.726 Cd/m2
47.50%	2.05 V	186.027 Cd/m2
45.00%	2.1 V	196.362 Cd/m2
42.50%	2.16 V	207.913 Cd/m2
40.00%	2.23 V	220.907 Cd/m2
37.50%	2.3 V	235.634 Cd/m2
35.00%	2.38 V	252.465 Cd/m2
32.50%	2.47 V	271.886 Cd/m2
30.00%	2.58 V	294.543 Cd/m2
27.50%	2.69 V	321.32 Cd/m2
25.00%	2.82 V	353.452 Cd/m2
22.50%	2.97 V	392.724 Cd/m2
20.00%	3.0 V	400.00 Cd/m2
17.50%	3.0 V	400.00 Cd/m2
15.00%	3.0 V	400.00 Cd/m2
12.50%	3.0 V	400.00 Cd/m2
10.00%	3.0 V	400.00 Cd/m2
7.50%	3.0 V	400.00 Cd/m2
5.00%	3.0 V	400.00 Cd/m2
2.50%	3.0 V	400.00 Cd/m2

[0039] The other reference levels, V1 to V7, can be adjusted in a linear way from the reference level V0. For example, the reference level Vn for a given average power level APL can then be computed as follows :

$$Vn(APL) = \frac{V0(APL) \times Vn(0\%)}{V0(0\%)}$$

[0040] The following table gives the voltage values of all the reference levels V0 to V7 for different APL :

Surface (white)	V0	V1	V2	V3	V4	V5	V6	V7
100.00%	1.41 V	1.22 V	1.03 V	0.66 V	0.28 V	0.14 V	0.08 V	0.0 V
97.50%	1.43 V	1.24 V	1.05 V	0.67 V	0.29 V	0.14 V	0.08 V	0.0 V
95.00%	1.45 V	1.25 V	1.06 V	0.68 V	0.29 V	0.14 V	0.08 V	0.0 V
92.50%	1.47 V	1.27 V	1.08 V	0.68 V	0.29 V	0.15 V	0.08 V	0.0 V
90.00%	1.49V	1.29V	1.09V	0.69 V	0.3 V	0.15 V	0.08 V	0.0 V
87.50%	1.51 V	1.31 V	1.11 V	0.7V	0.3V	0.15V	0.08V	0.0 V
85.00%	1.53V	1.33V	1.12V	0.71 V	0.31 V	0.15V	0.08V	0.0V

Table continued

Surface (white)	V0	V1	V2	V3	V4	V5	V6	V7
82.50%	1.55V	1.35V	1.14V	0.72V	0.31 V	0.16V	0.08V	0.0V
80.00%	1.58V	1.37V	1.16V	0.74V	0.32V	0.16V	0.08V	0.0 V
77.50%	1.6V	1.39V	1.18V	0.75V	0.32V	0.16V	0.09V	0.0 V
75.00%	1.63V	1.41 V	1.19V	0.76V	0.33V	0.16V	0.09V	0.0V
72.50%	1.66 V	1.44 V	1.21 V	0.77 V	0.33 V	0.17 V	0.09 V	0.0 V
70.00%	1.69V	1.46V	1.24V	0.79 V	0.34 V	0.17 V	0.09 V	0.0 V
67.50%	1.72V	1.49V	1.26V	0.8 V	0.34 V	0.17 V	0.09 V	0.0 V
65.00%	1.75 V	1.52 V	1.28 V	0.82 V	0.35 V	0.17 V	0.09 V	0.0 V
62.50%	1.78 V	1.55 V	1.31 V	0.83 V	0.36 V	0.18 V	0.1 V	0.0 V
60.00%	1.82 V	1.58 V	1.34 V	0.85 V	0.36 V	0.18 V	0.1 V	0.0 V
57.50%	1.86 V	1.61 V	1.36 V	0.87 V	0.37 V	0.19 V	0.1 V	0.0 V
55.00%	1.9V	1.65V	1.39V	0.89V	0.38V	0.19V	0.1 V	0.0 V
52.50%	1.95 V	1.69 V	1.43 V	0.91 V	0.39 V	0.19 V	0.1 V	0.0 V
50.00%	2.0 V	1.73V	1.46V	0.93 V	0.4 V	0.2 V	0.11 V	0.0 V
47.50%	2.05 V	1.77V	1.5V	0.96 V	0.41 V	0.2 V	0.11 V	0.0 V
45.00%	2.1 V	1.82 V	1.54 V	0.98 V	0.42 V	0.21 V	0.11 V	0.0 V
42.50%	2.16V	1.88V	1.59V	1.01 V	0.43V	0.22V	0.12V	0.0V
40.00%	2.23 V	1.93V	1.64V	1.04V	0.45 V	0.22 V	0.12 V	0.0 V
37.50%	2.3 V	2.0 V	1.69V	1.08V	0.46 V	0.23 V	0.12 V	0.0 V
35.00%	2.38 V	2.07 V	1.75 V	1.11 V	0.48 V	0.24 V	0.13 V	0.0 V
32.50%	2.47 V	2.14 V	1.81 V	1.15V	0.49 V	0.25 V	0.13 V	0.0 V
30.00%	2.58 V	2.23 V	1.89V	1.2V	0.52 V	0.26 V	0.14 V	0.0 V
27.50%	2.69 V	2.33 V	1.97 V	1.26 V	0.54 V	0.27 V	0.14 V	0.0 V
25.00%	2.82 V	2.45 V	2.07 V	1.32 V	0.56 V	0.28 V	0.15 V	0.0 V
22.50%	2.97V	2.58V	2.18V	1.39V	0.59V	0.3V	0.16V	0.0 V
20.00%	3.0 V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0 V
17.50%	3.0 V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0 V
15.00%	3.0 V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0 V
12.50%	3.0 V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0 V
10.00%	3.0 V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0 V
7.50%	3.0 V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0 V
5.00%	3.0 V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0 V
2.50%	3.0 V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0 V

[0041] Figure 3 shows curves illustrating this table and showing the variations of the reference voltages for the percentages of white surface 5%, 10%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100%.

[0042] A problem can appear when the voltage references related to the lowest gray levels are very low, which is the case in the above table for the reference voltages V5 and V6 when the picture load is high. Actually, in a voltage driven system, if the voltage is too low, the error (coming from the mismatch between neighbouring luminous elements) becomes higher than the required precision and the information is lost. In a current driven system, the problem is different. In such a system, the lower the current is, the longer it takes to load the capacitance of the luminous element. So, if the required current is too low, the writing time of the luminous element will be too long for a video application.

[0043] In the present example, the voltage values below 0.16V (bold values in the above table) can create a precision error. So, as an improvement, it is proposed to modify the reference voltages V1 to V7 in a non-linear way according to the reference level V0. The voltage values for the reference voltage V0 is kept constant while the other ones are modified by a non-linear mathematical transformation f(x,y,z) as followed:

$$Vn(APL) = f(V0(APL); Vn(0\%); V0(0\%)).$$

[0044] An example of the result of such a transformation is given in the next table:

Surface (white)	V0	V1	V2	V3	V4	V5	V6	V7
100.00%	1.41 V	1.35V	1.26V	0.97 V	0.5V	0.27 V	0.16V	0.0 V
97.50%	1.44V	1.38V	1.28V	0.97 V	0.5 V	0.27 V	0.16 V	0.0 V
95.00%	1.47V	1.4V	1.3V	0.98 V	0.5V	0.27 V	0.16V	0.0 V
92.50%	1.51 V	1.43V	1.32V	0.99V	0.5 V	0.27 V	0.16 V	0.0 V
90.00%	1.54V	1.45V	1.34V	1.0 V	0.51 V	0.27 V	0.16V	0.0 V
87.50%	1.57 V	1.48 V	1.36 V	1.01 V	0.51 V	0.27 V	0.16 V	0.0 V
85.00%	1.61 V	1.51 V	1.38 V	1.02 V	0.51 V	0.27 V	0.16 V	0.0 V
82.50%	1.65V	1.54V	1.4V	1.03V	0.51 V	0.27 V	0.16V	0.0 V
80.00%	1.68 V	1.57 V	1.42 V	1.04 V	0.51 V	0.27 V	0.16 V	0.0 V
77.50%	1.72V	1.6V	1.45V	1.05V	0.52 V	0.27 V	0.16V	0.0 V
75.00%	1.76 V	1.63 V	1.47 V	1.06 V	0.52 V	0.28 V	0.16 V	0.0 V
72.50%	1.81 V	1.66V	1.5V	1.07V	0.52 V	0.28 V	0.16V	0.0 V
70.00%	1.85V	1.7V	1.52V	1.09V	0.53 V	0.28 V	0.16V	0.0 V
67.50%	1.9V	1.73V	1.55V	1.1 V	0.53 V	0.28 V	0.16V	0.0 V
65.00%	1.94 V	1.77 V	1.58 V	1.11 V	0.53 V	0.28 V	0.16 V	0.0 V
62.50%	1.99V	1.81 V	1.61 V	1.12V	0.53 V	0.28 V	0.16V	0.0 V
60.00%	2.04 V	1.85V	1.64V	1.14V	0.54 V	0.28 V	0.16 V	0.0 V
57.50%	2.1 V	1.89V	1.67V	1.15V	0.54 V	0.28 V	0.16V	0.0 V
55.00%	2.15V	1.94V	1.7V	1.17V	0.55 V	0.28 V	0.16V	0.0 V
52.50%	2.21 V	1.98V	1.73V	1.18V	0.55 V	0.28 V	0.16 V	0.0 V
50.00%	2.27 V	2.03 V	1.77V	1.2V	0.55 V	0.29 V	0.16V	0.0 V
47.50%	2.33 V	2.08 V	1.81 V	1.22 V	0.56 V	0.29 V	0.16 V	0.0 V
45.00%	2.4 V	2.13 V	1.85V	1.24V	0.56 V	0.29 V	0.16 V	0.0 V
42.50%	2.47 V	2.18 V	1.89V	1.25V	0.57 V	0.29 V	0.16 V	0.0 V
40.00%	2.54 V	2.24 V	1.93V	1.27V	0.57 V	0.29 V	0.16 V	0.0 V
37.50%	2.61 V	2.29 V	1.97 V	1.29 V	0.57 V	0.29 V	0.16 V	0.0 V
35.00%	2.68 V	2.35 V	2.01 V	1.31 V	0.58 V	0.29 V	0.16 V	0.0 V
32.50%	2.76 V	2.41 V	2.06 V	1.33V	0.58 V	0.3V	0.16V	0.0V
30.00%	2.83 V	2.47 V	2.1 V	1.35V	0.59 V	0.3V	0.16V	0.0V
27.50%	2.9 V	2.52 V	2.14 V	1.37V	0.59 V	0.3 V	0.16 V	0.0V

Table continued

Surface (white)	V0	V1	V2	V3	V4	V5	V6	V7
25.00%	2.96 V	2.57 V	2.18V	1.39V	0.6V	0.3V	0.16V	0.0V
22.50%	3.0V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0V
20.00%	3.0V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0V
17.50%	3.0V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0V
15.00%	3.0V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0V
12.50%	3.0V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0V
10.00%	3.0V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0V
7.50%	3.0V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0V
5.00%	3.0V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0V
2.50%	3.0V	2.6V	2.2V	1.4V	0.6V	0.3V	0.16V	0.0V

[0045] Figure 4, to be compared with Figure 3, illustrates these new variations of voltage references V0 to V7 by curves. After this transformation, there are almost no more differences for the reference voltages V6 and V7 between the different APL values.

[0046] This non linear transformation f applied to the reference voltages V1 to V7 should be compensated by an inverse transformation f^{-1} in the video signal processing chain of the device. With such transformations (f and f^{-1}), it is possible to obtain an optimized power management without introducing too much difficulties in the low level gradations (low voltages/low currents).

[0047] A circuit implementation of the digital processing and driving unit 4 to be used the power level control method of the invention is given at figure 5.

[0048] An input picture is forwarded to a power evaluation block 41 that performs the computation of the APL level of the input picture. The APL value is transmitted to a power management block 42. Since the result of this computation can be only made after a complete frame, the input picture should be then stored in a frame memory 43, for example a DDRAM, in order to dispose of one frame delay. This memory can be inside or outside the unit 4.

[0049] Based on this APL value, an appropriate set of reference signals Refn is chosen for instance from a Look Up Table and sent to the Reference Signaling Unit 5 via a programming bus. Advantageously, a non-linear transformation f is integrated in these signals. As indicated previously, these reference signals can be reference voltages or reference currents. This programming should occur during the vertical blanking in order not to disturb the displayed picture.

[0050] In parallel to that, a non-linear transfer function f^{-1} (it can be a mathematical function or a Look Up Table) which is the inverse of the transformation integrated in the chosen set of reference signals Refn is chosen and is applied to the delayed picture by a block 44. The picture after processing is sent to a standard OLED processing block 45 and then to a standard OLED driving block 46 for finally driving the display with the current picture information.

[0051] The method of the invention can be used for controlling the contrast of the pictures displayed by the display device. In that case, the method consists in calculating an adjustment factor that is to be applied to the intensity of the signal supplied to the luminous elements in order to make the contrast go from a present value to a required value. This adjustment factor is then applied to the reference signals.

[0052] For example, for reducing the contrast by 50%, the reference signals are decreased from 50%.

Annexe 1

0	V7	0,00V	50	V5+(V4-V5)×957/1501	0,487V
1	V7+(V6-V7)×9/1175	0,001V	51	V5+(V4-V5)×1001/1501	0,496V
2	V7+(V6-V7)×32/1175	0,004V	52	V5+(V4-V5)×1045/1501	0,505V
3	V7+(V6-V7)×76/1175	0,01V	53	V5+(V4-V5)×1088/1501	0,514V
4	V7+(V6-V7)×141/1175	0,019V	54	V5+(V4-V5)×1131/1501	0,523V
5	V7+(V6-V7)×224/1175	0,03V	55	V5+(V4-V5)×1173/1501	0,532V
6	V7+(V6-V7)×321/1175	0,043V	56	V5+(V4-V5)×1215/1501	0,541V
7	V7+(V6-V7)×425/1175	0,057V	57	V5+(V4-V5)×1257/1501	0,55V
8	V7+(V6-V7)×529/1175	0,071V	58	V5+(V4-V5)×1298/1501	0,559V
9	V7+(V6-V7)×630/1175	0,084V	59	V5+(V4-V5)×1339/1501	0,567V
10	V7+(V6-V7)×727/1175	0,097V	60	V5+(V4-V5)×1380/1501	0,576V
11	V7+(V6-V7)×820/1175	0,11V	61	V5+(V4-V5)×1421/1501	0,584V
12	V7+(V6-V7)×910/1175	0,122V	62	V5+(V4-V5)×1461/1501	0,593V
13	V7+(V6-V7)×998/1175	0,133V	63	V4	0,601V
14	V7+(V6-V7)×1086/1175	0,145V	64	V4+(V3-V4)×40/2215	0,615V
15	V6	0,157V	65	V4+(V3-V4)×80/2215	0,628V
16	V6+(V5-V6)×89/1097	0,167V	66	V4+(V3-V4)×120/2215	0,641V
17	V6+(V5-V6)×173/1097	0,177V	67	V4+(V3-V4)×160/2215	0,654V
18	V6+(V5-V6)×250/1097	0,186V	68	V4+(V3-V4)×200/2215	0,667V
19	V6+(V5-V6)×320/1097	0,194V	69	V4+(V3-V4)×240/2215	0,681V
20	V6+(V5-V6)×386/1097	0,202V	70	V4+(V3-V4)×280/2215	0,694V
21	V6+(V5-V6)×451/1097	0,21V	71	V4+(V3-V4)×320/2215	0,707V
22	V6+(V5-V6)×517/1097	0,217V	72	V4+(V3-V4)×360/2215	0,72V
23	V6+(V5-V6)×585/1097	0,225V	73	V4+(V3-V4)×400/2215	0,734V
24	V6+(V5-V6)×654/1097	0,233V	74	V4+(V3-V4)×440/2215	0,747V
25	V6+(V5-V6)×723/1097	0,241V	75	V4+(V3-V4)×480/2215	0,76V
26	V6+(V5-V6)×790/1097	0,249V	76	V4+(V3-V4)×520/2215	0,773V
27	V6+(V5-V6)×855/1097	0,257V	77	V4+(V3-V4)×560/2215	0,787V
28	V6+(V5-V6)×917/1097	0,264V	78	V4+(V3-V4)×600/2215	0,80V
29	V6+(V5-V6)×977/1097	0,271V	79	V4+(V3-V4)×640/2215	0,813V
30	V6+(V5-V6)×1037/1097	0,278V	80	V4+(V3-V4)×680/2215	0,826V
31	V5	0,285V	81	V4+(V3-V4)×719/2215	0,839V
32	V5+(V4-V5)×60/1501	0,298V	82	V4+(V3-V4)×758/2215	0,852V
33	V5+(V4-V5)×119/1501	0,31V	83	V4+(V3-V4)×796/2215	0,865V
34	V5+(V4-V5)×176/1501	0,322V	84	V4+(V3-V4)×834/2215	0,877V
35	V5+(V4-V5)×231/1501	0,334V	85	V4+(V3-V4)×871/2215	0,889V
36	V5+(V4-V5)×284/1501	0,345V	86	V4+(V3-V4)×908/2215	0,902V
37	V5+(V4-V5)×335/1501	0,356V	87	V4+(V3-V4)×944/2215	0,914V
38	V5+(V4-V5)×385/1501	0,366V	88	V4+(V3-V4)×980/2215	0,925V
39	V5+(V4-V5)×434/1501	0,376V	89	V4+(V3-V4)×1016/2215	0,937V
40	V5+(V4-V5)×483/1501	0,387V	90	V4+(V3-V4)×1052/2215	0,949V
41	V5+(V4-V5)×532/1501	0,397V	91	V4+(V3-V4)×1087/2215	0,961V
42	V5+(V4-V5)×580/1501	0,407V	92	V4+(V3-V4)×1122/2215	0,972V
43	V5+(V4-V5)×628/1501	0,417V	93	V4+(V3-V4)×1157/2215	0,984V
44	V5+(V4-V5)×676/1501	0,427V	94	V4+(V3-V4)×1192/2215	0,996V
45	V5+(V4-V5)×724/1501	0,438V	95	V4+(V3-V4)×1226/2215	1,007V
46	V5+(V4-V5)×772/1501	0,448V	96	V4+(V3-V4)×1260/2215	1,018V
47	V5+(V4-V5)×819/1501	0,458V	97	V4+(V3-V4)×1294/2215	1,029V
48	V5+(V4-V5)×866/1501	0,468V	98	V4+(V3-V4)×1328/2215	1,04V
49	V5+(V4-V5)×912/1501	0,477V	99	V4+(V3-V4)×1362/2215	1,052V

Annexe 1

100	V4+(V3-V4)×1396/2215	1,063V	150	V3+(V2-V3)×777/2343	1,581V
101	V4+(V3-V4)×1429/2215	1,074V	151	V3+(V2-V3)×813/2343	1,593V
102	V4+(V3-V4)×1462/2215	1,085V	152	V3+(V2-V3)×849/2343	1,604V
103	V4+(V3-V4)×1495/2215	1,096V	153	V3+(V2-V3)×885/2343	1,616V
104	V4+(V3-V4)×1528/2215	1,107V	154	V3+(V2-V3)×921/2343	1,627V
105	V4+(V3-V4)×1561/2215	1,118V	155	V3+(V2-V3)×958/2343	1,639V
106	V4+(V3-V4)×1593/2215	1,128V	156	V3+(V2-V3)×995/2343	1,651V
107	V4+(V3-V4)×1625/2215	1,139V	157	V3+(V2-V3)×1032/2343	1,663V
108	V4+(V3-V4)×1657/2215	1,149V	158	V3+(V2-V3)×1069/2343	1,674V
109	V4+(V3-V4)×1688/2215	1,16V	159	V3+(V2-V3)×1106/2343	1,686V
110	V4+(V3-V4)×1719/2215	1,17V	160	V3+(V2-V3)×1143/2343	1,698V
111	V4+(V3-V4)×1750/2215	1,18V	161	V3+(V2-V3)×1180/2343	1,71V
112	V4+(V3-V4)×1781/2215	1,19V	162	V3+(V2-V3)×1217/2343	1,722V
113	V4+(V3-V4)×1811/2215	1,20V	163	V3+(V2-V3)×1255/2343	1,734V
114	V4+(V3-V4)×1841/2215	1,21V	164	V3+(V2-V3)×1293/2343	1,746V
115	V4+(V3-V4)×1871/2215	1,22V	165	V3+(V2-V3)×1331/2343	1,758V
116	V4+(V3-V4)×1901/2215	1,23V	166	V3+(V2-V3)×1369/2343	1,77V
117	V4+(V3-V4)×1930/2215	1,24V	167	V3+(V2-V3)×1407/2343	1,782V
118	V4+(V3-V4)×1959/2215	1,249V	168	V3+(V2-V3)×1445/2343	1,794V
119	V4+(V3-V4)×1988/2215	1,259V	169	V3+(V2-V3)×1483/2343	1,806V
120	V4+(V3-V4)×2016/2215	1,268V	170	V3+(V2-V3)×1521/2343	1,819V
121	V4+(V3-V4)×2044/2215	1,277V	171	V3+(V2-V3)×1559/2343	1,831V
122	V4+(V3-V4)×2072/2215	1,287V	172	V3+(V2-V3)×1597/2343	1,843V
123	V4+(V3-V4)×2100/2215	1,296V	173	V3+(V2-V3)×1635/2343	1,855V
124	V4+(V3-V4)×2128/2215	1,305V	174	V3+(V2-V3)×1673/2343	1,867V
125	V4+(V3-V4)×2156/2215	1,314V	175	V3+(V2-V3)×1712/2343	1,879V
126	V4+(V3-V4)×2185/2215	1,324V	176	V3+(V2-V3)×1751/2343	1,892V
127	V3	1,334V	177	V3+(V2-V3)×1790/2343	1,904V
128	V3+(V2-V3)×31/2343	1,344V	178	V3+(V2-V3)×1829/2343	1,917V
129	V3+(V2-V3)×64/2343	1,354V	179	V3+(V2-V3)×1868/2343	1,929V
130	V3+(V2-V3)×97/2343	1,365V	180	V3+(V2-V3)×1907/2343	1,942V
131	V3+(V2-V3)×130/2343	1,375V	181	V3+(V2-V3)×1946/2343	1,954V
132	V3+(V2-V3)×163/2343	1,386V	182	V3+(V2-V3)×1985/2343	1,966V
133	V3+(V2-V3)×196/2343	1,396V	183	V3+(V2-V3)×2024/2343	1,979V
134	V3+(V2-V3)×229/2343	1,407V	184	V3+(V2-V3)×2064/2343	1,992V
135	V3+(V2-V3)×262/2343	1,417V	185	V3+(V2-V3)×2103/2343	2,004V
136	V3+(V2-V3)×295/2343	1,428V	186	V3+(V2-V3)×2143/2343	2,017V
137	V3+(V2-V3)×328/2343	1,438V	187	V3+(V2-V3)×2183/2343	2,03V
138	V3+(V2-V3)×361/2343	1,449V	188	V3+(V2-V3)×2223/2343	2,042V
139	V3+(V2-V3)×395/2343	1,46V	189	V3+(V2-V3)×2263/2343	2,055V
140	V3+(V2-V3)×429/2343	1,471V	190	V3+(V2-V3)×2303/2343	2,068V
141	V3+(V2-V3)×463/2343	1,481V	191	V2	2,081V
142	V3+(V2-V3)×497/2343	1,492V	192	V2+(V1-V2)×40/1638	2,09V
143	V3+(V2-V3)×531/2343	1,503V	193	V2+(V1-V2)×81/1638	2,10V
144	V3+(V2-V3)×566/2343	1,514V	194	V2+(V1-V2)×124/1638	2,11V
145	V3+(V2-V3)×601/2343	1,525V	195	V2+(V1-V2)×168/1638	2,121V
146	V3+(V2-V3)×636/2343	1,536V	196	V2+(V1-V2)×213/1638	2,131V
147	V3+(V2-V3)×671/2343	1,548V	197	V2+(V1-V2)×259/1638	2,142V
148	V3+(V2-V3)×706/2343	1,559V	198	V2+(V1-V2)×306/1638	2,153V
149	V3+(V2-V3)×741/2343	1,57V	199	V2+(V1-V2)×353/1638	2,165V

Annexe 1

200	V2+(V1-V2)×401/1638	2,176V
201	V2+(V1-V2)×450/1638	2,188V
202	V2+(V1-V2)×499/1638	2,199V
203	V2+(V1-V2)×548/1638	2,211V
204	V2+(V1-V2)×597/1638	2,223V
205	V2+(V1-V2)×646/1638	2,234V
206	V2+(V1-V2)×695/1638	2,246V
207	V2+(V1-V2)×745/1638	2,258V
208	V2+(V1-V2)×795/1638	2,27V
209	V2+(V1-V2)×846/1638	2,282V
210	V2+(V1-V2)×897/1638	2,294V
211	V2+(V1-V2)×949/1638	2,307V
212	V2+(V1-V2)×1002/1638	2,319V
213	V2+(V1-V2)×1056/1638	2,332V
214	V2+(V1-V2)×1111/1638	2,345V
215	V2+(V1-V2)×1167/1638	2,359V
216	V2+(V1-V2)×1224/1638	2,372V
217	V2+(V1-V2)×1281/1638	2,386V
218	V2+(V1-V2)×1339/1638	2,40V
219	V2+(V1-V2)×1398/1638	2,414V
220	V2+(V1-V2)×1458/1638	2,428V
221	V2+(V1-V2)×1518/1638	2,442V
222	V2+(V1-V2)×1578/1638	2,457V
223	V1	2,471V
224	V1+(V0-V1)×60/3029	2,478V
225	V1+(V0-V1)×120/3029	2,486V
226	V1+(V0-V1)×180/3029	2,493V
227	V1+(V0-V1)×241/3029	2,501V
228	V1+(V0-V1)×304/3029	2,509V
229	V1+(V0-V1)×369/3029	2,517V
230	V1+(V0-V1)×437/3029	2,526V
231	V1+(V0-V1)×507/3029	2,534V
232	V1+(V0-V1)×580/3029	2,544V
233	V1+(V0-V1)×655/3029	2,553V
234	V1+(V0-V1)×732/3029	2,563V
235	V1+(V0-V1)×810/3029	2,572V
236	V1+(V0-V1)×889/3029	2,582V
237	V1+(V0-V1)×969/3029	2,592V
238	V1+(V0-V1)×1050/3029	2,602V
239	V1+(V0-V1)×1133/3029	2,613V
240	V1+(V0-V1)×1218/3029	2,623V
241	V1+(V0-V1)×1304/3029	2,634V
242	V1+(V0-V1)×1393/3029	2,645V
243	V1+(V0-V1)×1486/3029	2,657V
244	V1+(V0-V1)×1583/3029	2,669V
245	V1+(V0-V1)×1686/3029	2,682V
246	V1+(V0-V1)×1794/3029	2,695V
247	V1+(V0-V1)×1907/3029	2,71V
248	V1+(V0-V1)×2026/3029	2,724V
249	V1+(V0-V1)×2150/3029	2,74V

250	V1+(V0-V1)×2278/3029	2,756V
251	V1+(V0-V1)×2411/3029	2,773V
252	V1+(V0-V1)×2549/3029	2,79V
253	V1+(V0-V1)×2694/3029	2,808V
254	V1+(V0-V1)×2851/3029	2,828V
255	V0	2,85V

Claims

1. Method for controlling the power level and/or the contrast in a display device having a plurality of luminous elements corresponding to the colour components of the pixels of a picture, wherein the luminance generated by each of said luminous elements is based on the intensity of the signal supplied to the luminous element and the power level and/or contrast for each picture is controlled by adjusting the intensity of the signal to be supplied to each luminous element,
characterized in that the intensity of the signal to be supplied to each luminous element is based on reference signals and **in that** the adjustment of the signal intensity is made by adjusting the level of the reference signals.

2. Method according to claim 1, **characterized in that**, for controlling the power level, it further comprises the following steps :

    - calculating, for each picture received by the display device, a parameter representative of the power needed by the display device for displaying said picture, and
    - adjusting the intensity of the signal to be supplied to each luminous element in order that the power needed by the display device for displaying said picture is lower than a target value.

3. Method according to claim 2, **characterized in that** the parameter representative of the power needed by the display device for displaying a picture is the average power level of said picture.

4. Method according to claim 1, **characterized in that**, for the controlling the contrast of the pictures displayed by the display device, it further comprises the following steps :

    - calculating an adjustment factor to be applied to the intensity of the picture signal supplied to the luminous elements in order that the resulting contrast is equal to a required contrast, and
    - applying said adjustment factor to said reference signals.

5. Method according to one of claims 1 to 4, **characterized in that**, before adjustment of the signal intensity, a non linear transformation (f) is applied to reference signals in order to increase the amplitude of the low-amplitude reference signals and **in that** the inverse transformation (f^{-1}) is applied to the picture signal.

6. Method according to one of claims 1 to 5, **characterized in that** the luminous elements are organic light emitting display diodes .

7. Method according to one of claims 1 to 6, **characterized in that** the reference signals are reference voltages or reference currents.

8. Apparatus for controlling the power level and/or the contrast in a display device having a plurality of luminous elements corresponding to the colour components of the pixels of a picture, wherein the luminance generated by each of said luminous elements is based on the intensity of the signal supplied to the luminous element and the power level and/or contrast for each picture is controlled by adjusting the intensity of the signal to be supplied to each luminous element,
characterized in that the intensity of the signal to be supplied to each luminous element is based on reference signals and **in that** it comprises adjustment means (42) for modifying the signal intensity by adjusting the level of the reference signals.

9. Apparatus according to claim 8, **characterized in that**, for controlling the power level, it further comprises calculation means (41) for calculating, for each picture received by the display device, a parameter representative of the power needed by the display device for displaying said picture, and **in that** the adjustment means (42) adjusts the level of the reference signals in order that the power needed by the display device for displaying each picture is lower than a target value.

10. Apparatus according to claim 9, **characterized in that** the calculation means (41) calculates, for each picture received by the display device, the average power level of said picture.

11. Apparatus according to claim 8, **characterized in that**, for controlling the contrast of the pictures displayed by the display device, it further comprises calculation means for calculating an adjustment factor to be applied to the

intensity of the signal supplied to the luminous elements in order that the resulting contrast is equal to a required contrast, and **in that** the adjustment means applies said adjustment factor to said reference signals.

12. Apparatus according to one of claims 8 to 11, **characterized in that** it comprises a frame memory (43) for storing a picture before transmitting it to the display device.

13. Apparatus according to claim 8 or 11, **characterized in that** the adjustment means (42) comprises means for applying a non linear transformation (f) to reference signals and **in that** it comprises means (44) for applying the inverse transformation (f^{-1}) to the picture signal.

14. Display device comprising

- a plurality of organic light emitting diodes (1),
- signal processing means (4) for processing the picture signal received by the display device,
- driving means (2, 3) for driving said plurality of organic light emitting diodes (1) according to the signal processed by the signal processing means (4),
- reference signalling means (5) for outputting reference signals to the driving means (3),

characterized in that said signal processing means (4) comprises an apparatus according to claim 8 to 13.

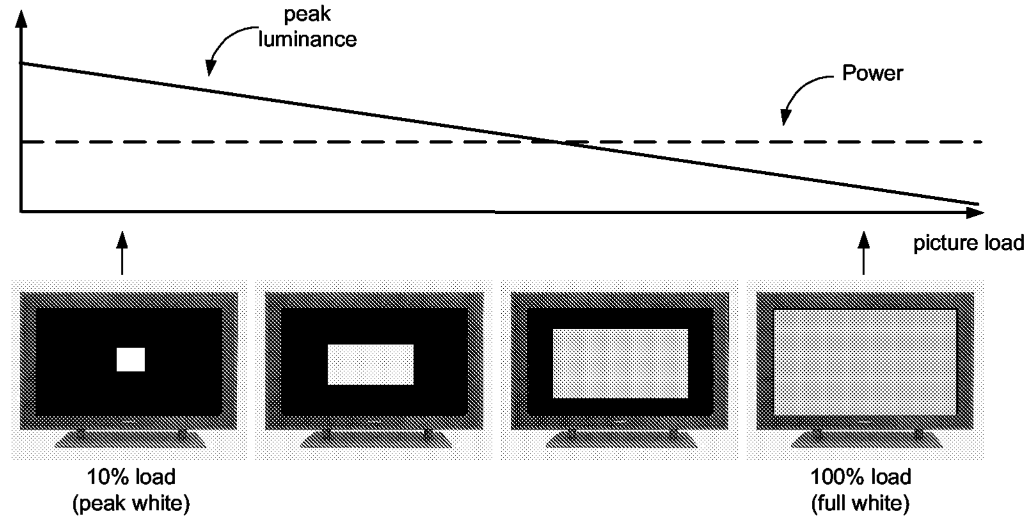

FIGURE 1

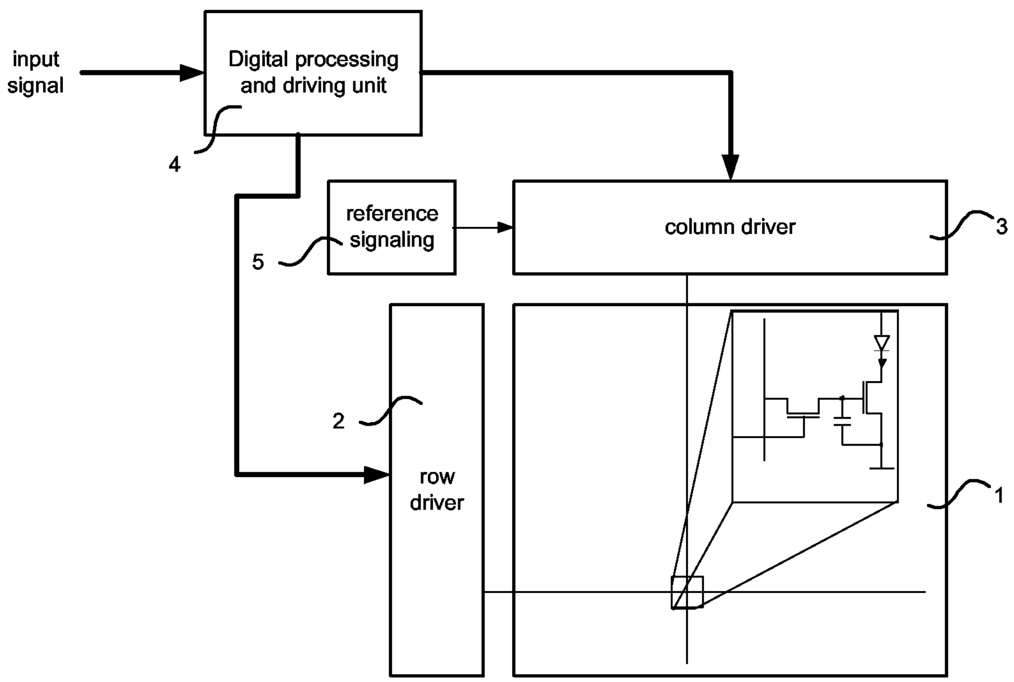

FIGURE 2

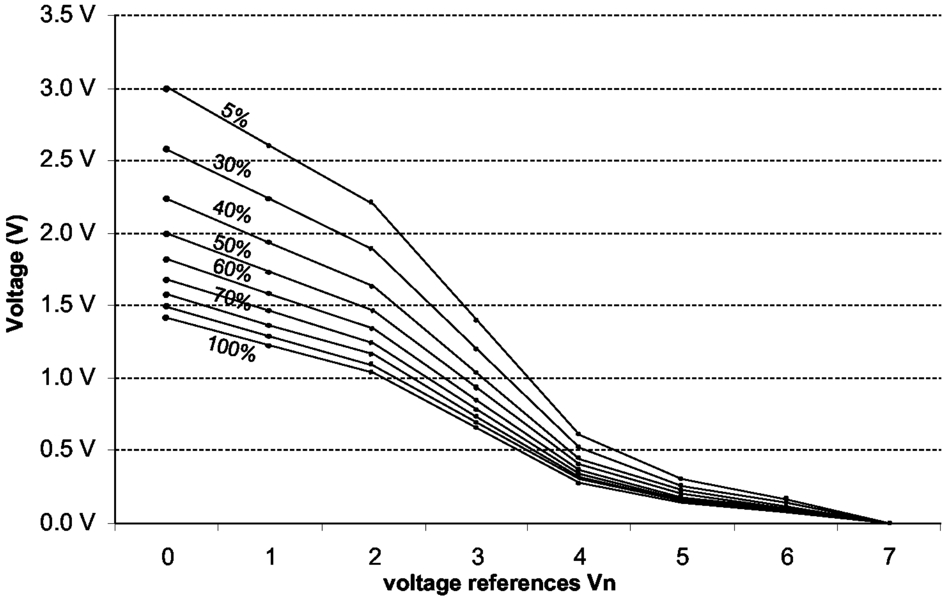

FIGURE 3

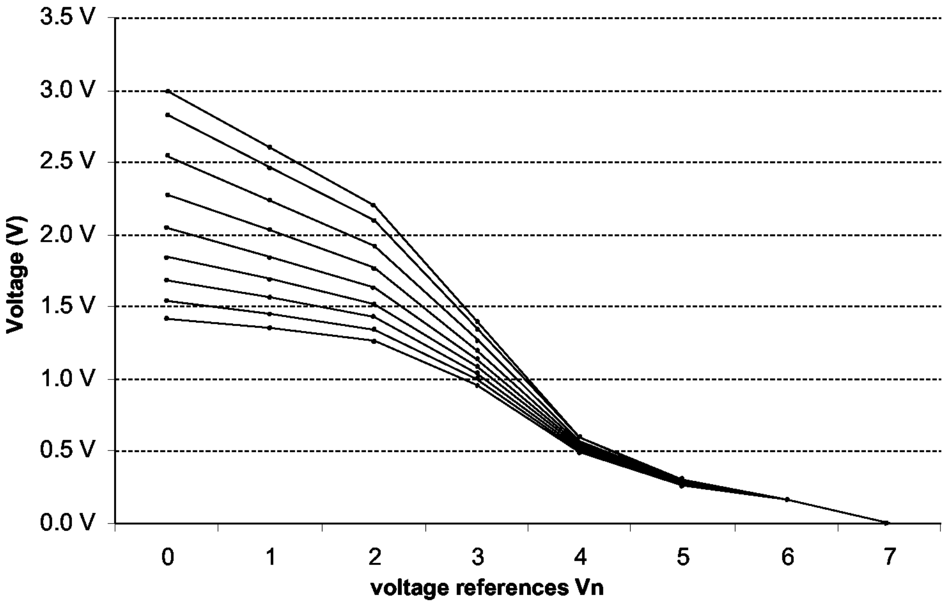

FIGURE 4

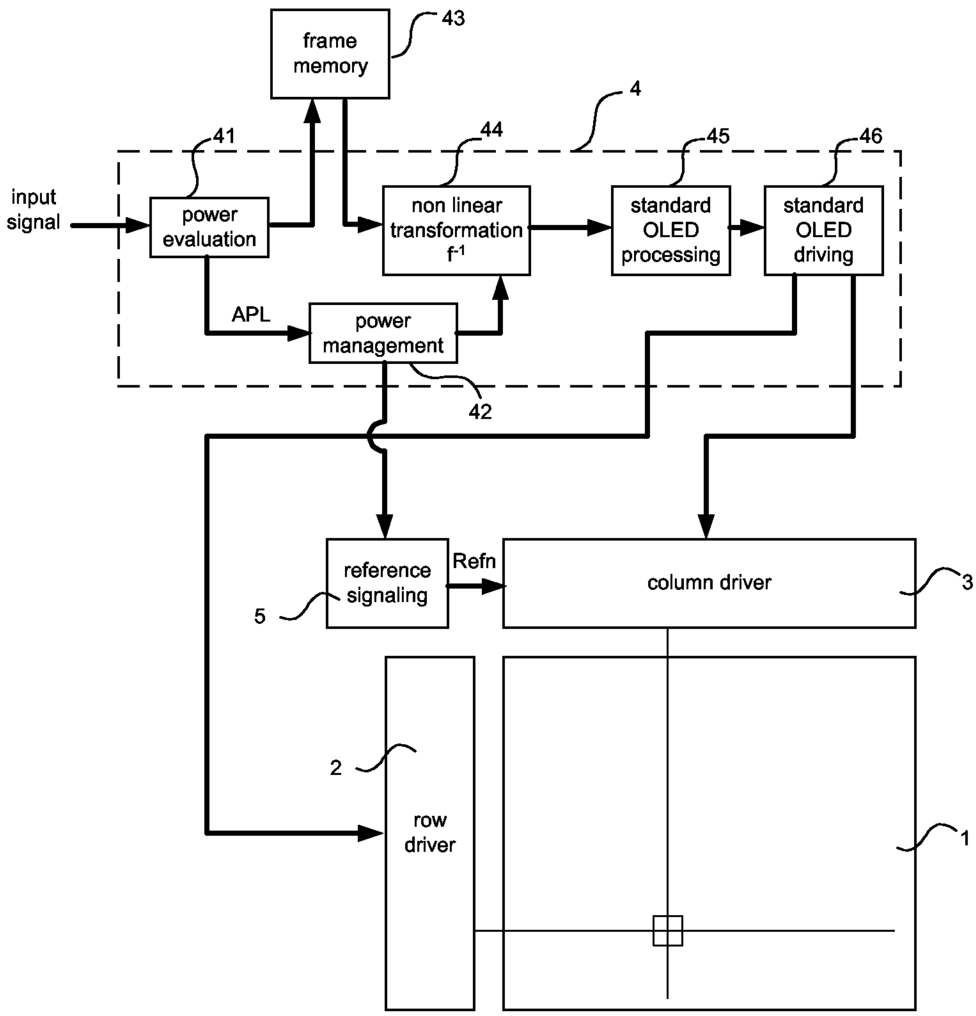
frame memory
43
4
41
44
45
46
input signal
power evaluation
non linear transformation f^{-1}
standard OLED processing
standard OLED driving
APL
power management
42
reference signaling
Refn
column driver
3
5
2
row driver
1

FIGURE 5

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EUROPEAN SEARCH REPORT

Application Number
EP 05 10 6877

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 2003/218583 A1 (HASAGAWA HIROSHI) 27 November 2003 (2003-11-27) * the whole document * -----	1-4, 6-11,14	G09G3/32
X	EP 1 310 935 A (CANON KK) 14 May 2003 (2003-05-14) * the whole document * -----	1-4, 6-12,14	
X	EP 1 164 562 A (FUJITSU HITACHI PLASMA DISPLAY) 19 December 2001 (2001-12-19) * the whole document * -----	1-4, 6-11,14	
X	PATENT ABSTRACTS OF JAPAN vol. 2002, no. 10, 10 October 2002 (2002-10-10) -& JP 2002 182612 A (SONY CORP), 26 June 2002 (2002-06-26) * the whole document * -----	1-4, 6-11,14	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

G09G

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	7 October 2005	Harke, M

CATEGORY OF CITED DOCUMENTS

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07-10-2005

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

专利名称(译)	用于显示设备的功率电平控制和/或对比度控制的方法和设备		
公开(公告)号	EP1624438A1	公开(公告)日	2006-02-08
申请号	EP2005106877	申请日	2005-07-26
[标]申请(专利权)人(译)	汤姆森特许公司		
申请(专利权)人(译)	汤姆森许可		
当前申请(专利权)人(译)	汤姆森许可		
[标]发明人	WEITBRUCH SEBASTIEN COTA DENNIS LE ROY PHILIPPE		
发明人	WEITBRUCH, SEBASTIEN COTA, DENNIS LE ROY, PHILIPPE		
IPC分类号	G09G3/32		
CPC分类号	G09G3/3225 G09G2320/0626 G09G2320/066 G09G2330/021 G09G2360/16		
代理机构(译)	LE DANTEC，CLAUDE		
优先权	2004291945 2004-07-29 EP		
其他公开文献	EP1624438B1		
外部链接	Espacenet		

摘要(译)

本发明涉及一种用于控制具有多个发光元件的显示装置中的功率电平和/或对比度的方法和装置，所述多个发光元件对应于图像的像素的颜色分量，其中由所述发光元件的亮度基于提供给发光元件的信号的强度，并且通过调节提供给每个发光元件的信号的强度来控制每个图像的功率电平和/或对比度。本发明适用于有机发光显示器（OLED）。根据本发明，要提供给每个发光元件的信号的强度基于参考信号，并且通过调整参考信号的电平来进行信号强度的调整。

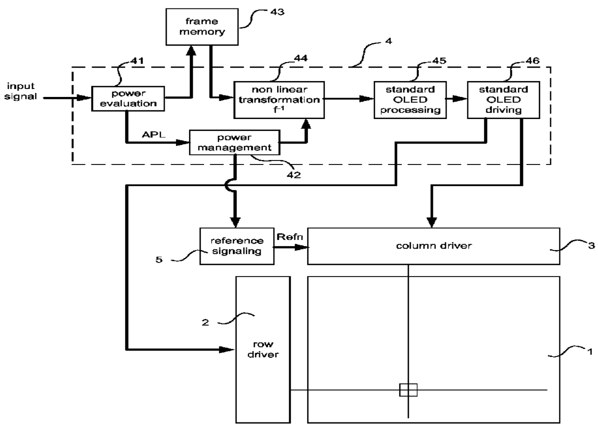

FIGURE 5