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(54) IMAGE DISPLAY APPARATUS

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(57) **ABSTRACT**

An image display apparatus with pixels where each of the pixels has a light emitting element such as an organic EL (electro-luminescence) element. The brightness of the light emitting element is controlled by the current flowing in the light emitting element. The image display apparatus adjusts the amplitude of the white gray levels in accordance with average brightness of a screen displayed by RGB data.

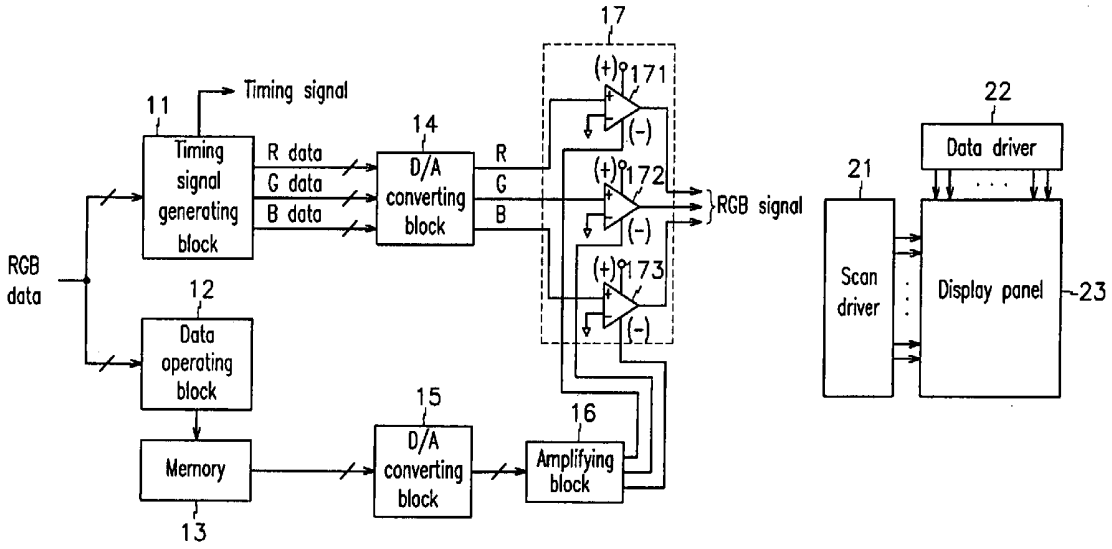

FIG.1

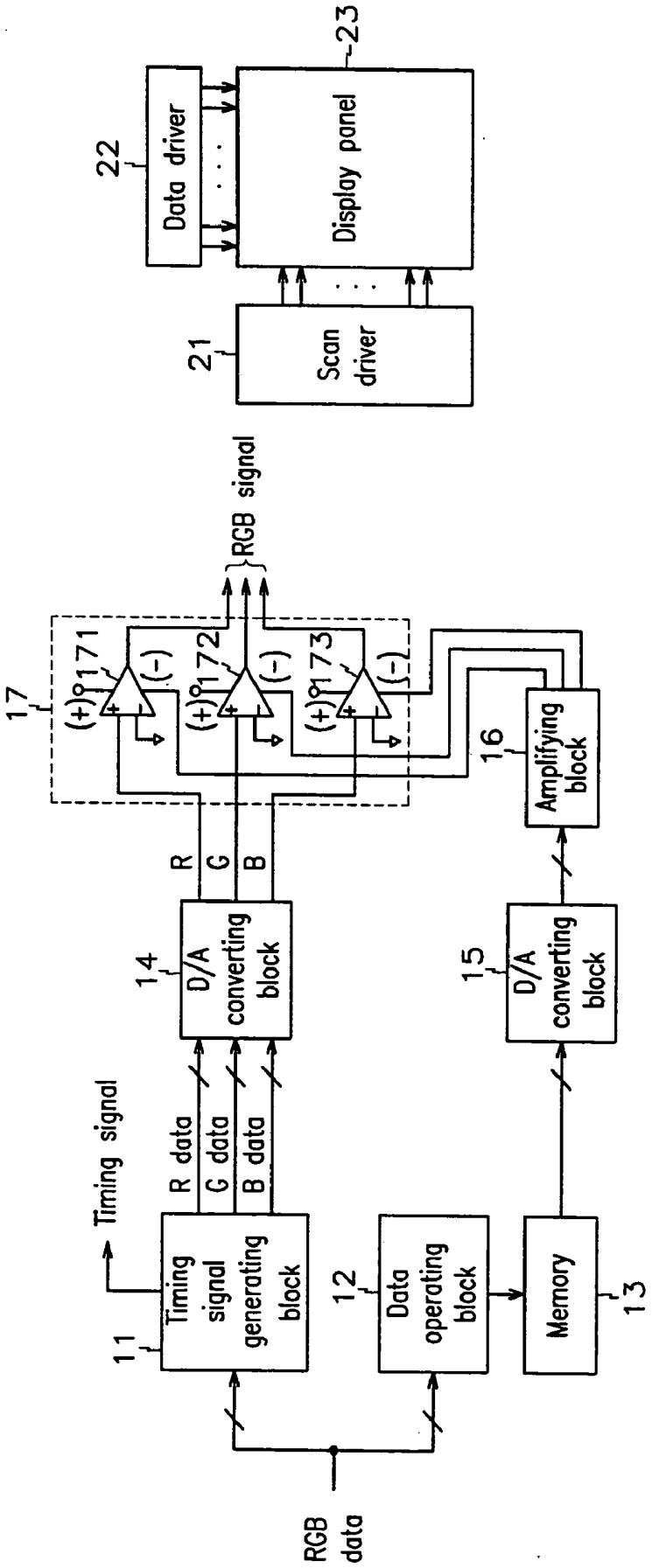
RGB data
11
Timing signal generating block
Timing signal
R data
G data
B data
12
Data operating block
13
Memory
14
D/A converting block
15
D/A converting block
16
Amplifying block
17
171
172
173
(+)
(-)
R
G
B
RGB signal
21
Scan driver
22
Data driver
23
Display panel

FIG.2

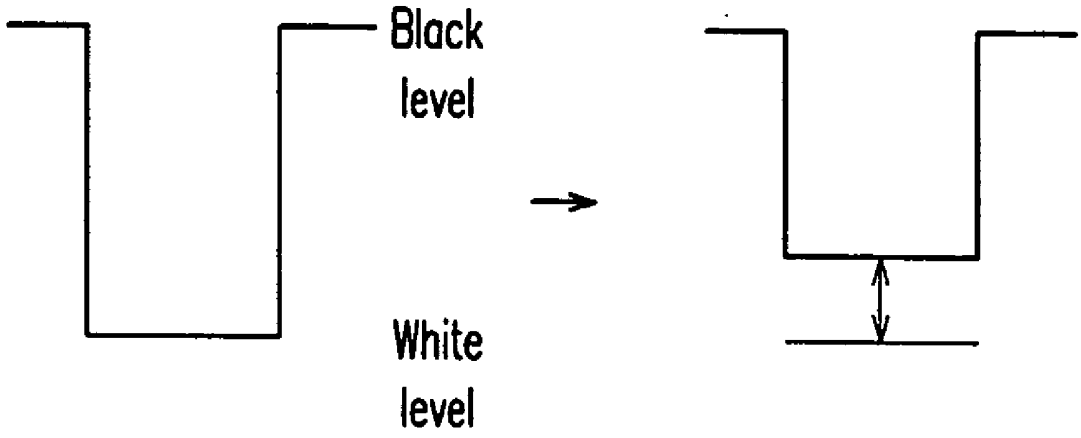

IMAGE DISPLAY APPARATUS

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is based on Korean Patent Application No. 10-2003-0010665 filed on Feb. 20, 2003, in the Korean Intellectual Property Office, the content of which is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] a. Field of the Invention

[0003] The invention relates to an image display apparatus having pixels where the brightness of each pixel is controlled by a display signal. More specifically, the invention relates to an image display apparatus having pixels where a light emitting element such as an organic EL (electroluminescence) element is provided with each pixel and the brightness of the light emitting element is controlled by the amount of current flowing in the light emitting element. Moreover, the invention relates to an image display apparatus of an active matrix type where current supplied to a light emitting element is controlled by an active device, such as an insulating gate type FET (field effect transistor), which is provided in each pixel.

[0004] b. Description of the Related Art

[0005] In general, a plurality of pixels are arranged in a matrix in an active matrix type image display apparatus, and an image is displayed by controlling the light intensity of each pixel in accordance with the brightness information provided from an external graphic source.

[0006] An organic EL image display apparatus is a self-emitting display by having a plurality of pixels and each of pixels having a light emitting element such as an OLED (organic light emitting diode). Organic EL image display apparatus are advantageous in comparison with a liquid crystal display because organic EL image display apparatus have favorable visibility, do not require a backlight, and they have a high display response speed. Brightness of each light emitting element is controlled by controlling the amount of current flowing in each light emitting element. In other words, the organic EL image display apparatus has a different property from the liquid crystal display in that the brightness of each light emitting element in the organic EL image display apparatus is directly controlled by the current flowing in each light emitting element, while the brightness of each pixel in the liquid crystal display is indirectly controlled by a light emitting means such as a backlight.

[0007] There are two general driving methods for driving organic EL image display apparatus. There is a passive matrix driving method and an active matrix driving method. The passive matrix driving method enables a simple panel structure in a display apparatus, but has difficulty realizing a large panel size and high definition of a display apparatus. Thus, a display apparatus using the active matrix driving method has been developed. In an organic EL image display apparatus using the active matrix driving method, current flowing in a light emitting element provided at each pixel is controlled by an active device provided at each pixel. The active device may be, for example, a thin film transistor which is a kind of an insulating gate type field effect transistor.

[0008] In a conventional organic EL image display apparatus configured as above, display operation is performed by a driving method where fixed gray levels regardless of brightness distribution by inputted RGB image data are used for display operation. That is, display operation is performed with fixed gray levels, and the display operation does not depend on whether the brightness of the display screen is high or low. The brightness of the display screen may be determined by the brightness distribution of RGB data. According to the above driving method, however, the brightness difference in a display screen becomes large when a difference between the number of ON-pixels and OFF-pixels is large. The brightness difference causes an uneven display in a screen. To solve the above problem, it is possible to reduce the steps of neighboring gray levels. However, this solution still has a problem of a representation limit due to a decrease of steps in neighboring gray levels. Thus, it is required that the steps of the neighboring gray levels should be variably adjusted in accordance with the brightness level of the display screen.

SUMMARY OF THE INVENTION

[0009] The invention provides an image display apparatus which may adjust steps of neighboring gray levels variably in accordance with a brightness level of a display screen.

[0010] The image display apparatus according to the invention includes a display panel having pixels arranged in a matrix and for performing a display operation, a scan driver for sequentially selecting pixel lines of the display panel, and a data driver for applying color signals to a corresponding pixel line when the pixel line of the display panel is selected. The display apparatus further includes a display controller for receiving color data and generating timing signals for controlling the drivers, while transforming the color data into analog signals and performing gamma correction to the transformed analog signals to generate color signals. The display controller determines reference data for brightness adjustment in accordance with an average brightness of a screen displayed by the color data and performs gamma correction by adjusting gray levels of the RGB data in accordance with the reference data for brightness adjustment.

[0011] According to the image display apparatus of the invention, an amplitude of the white gray levels may be adjusted in accordance with an average brightness of a screen displayed by color data. Thus, at least a problem of uneven display in a screen due to a brightness difference may be solved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate an exemplary embodiment of the invention, and, together with the description, serve to explain the principles of the invention.

[0013] **FIG. 1** illustrates overall block diagram of an image display apparatus in accordance with an exemplary embodiment of the invention.

[0014] **FIG. 2** illustrates brightness adjustment procedure of white level in the image display apparatus shown in **FIG. 1**.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0015] In the following detailed description, only the exemplary embodiment of the invention has been shown and described, simply by way of illustration of the best mode contemplated by the inventor(s) of carrying out the invention. As will be realized, the invention is capable of modification in various obvious respects, all without departing from the invention. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not restrictive.

[0016] **FIG. 1** illustrates an overall block diagram of an image display apparatus in accordance with an embodiment of the invention.

[0017] As shown in **FIG. 1**, the image display apparatus of the exemplary embodiment comprises a timing signal generating block **11**, a data operating block **12**, a memory **13**, D/A converting blocks **14** and **15**, an amplifying block **16**, a differential amplifying block **17**, a scan driver **21**, a data driver **22**, and a display panel **23**. The timing signal generating block **11**, the data operating block **12**, the memory **13**, the D/A converting blocks **14** and **15**, the amplifying block **16**, and the differential amplifying block **17** operate as a display controller of the image display apparatus. The display controller configured as above receives RGB data and generates timing signals for controlling display operation of the display panel **23**. Moreover, the display controller generates RGB signals for driving each pixel of the display panel **23** by using the inputted RGB data. In particular, the display controller may adjust steps of neighboring gray levels. More specifically, for example, the display controller may adjust the amplitude of white gray level, in accordance with the brightness level of a screen displayed by the RGB data. The brightness level may be regarded as the average brightness of a screen. In this exemplary embodiment, this function of adjusting steps of neighboring gray levels is performed by the data operating block **12**, the memory **13**, the D/A converting block **15**, the amplifying block **16**, and the differential amplifying block **17**. It is of course possible to configure the image display apparatus such that the amplitude of white gray levels may be adjusted in units of each RGB color.

[0018] Next, operation of the image display apparatus will be described.

[0019] First, RGB data which is outputted from a graphic source outside of the image display apparatus, such as a mobile phone or a PDA (personal digital assistant) etc., is inputted into the timing signal generating block **11** and the data operating block **12**. The data operating block **12** calculates the average brightness of one screen to be displayed by the RGB data, and outputs address information corresponding to the calculated average brightness. The memory **13** stores reference data for brightness adjustment as data information corresponding to the addresses of the memory **13**. Thus, the reference data are matched with a value of the average brightness. Accordingly, the memory **13** outputs reference data for brightness adjustment in response to the address information outputted from the data operating block **12**.

[0020] The reference data for brightness adjustment comprises red color components, green color components, and blue color components. In this embodiment, it is assumed that the reference data for the brightness adjustment corresponds to the average brightness value of one display screen. For example, when the average brightness has a high value, the reference data for brightness adjustment is set to be high. When the average brightness has a low value, the reference data for brightness adjustment is set to be low. Then, the white gray level of the RGB data is controlled by using the reference data for brightness adjustment. Then, RGB signals having adjusted brightness may be obtained. The display operation of the display panel **23** is performed by the above obtained RGB signals. Therefore, the brightness difference in a certain display screen due to a difference between the number of ON-pixels and OFF-pixels may be decreased because RGB signals are adjusted in accordance with the average brightness value of the screen regardless of the difference between the number of ON-pixels and OFF-pixels.

[0021] Meanwhile, the timing signal generating block **11** receives RGB data and generates timing signals for controlling the display operation of the display panel **23** by using the received is RGB data. The generated timing signals are commonly outputted to the scan driver **21** and the data driver **22**. The scan driver **21** sequentially selects pixels of the display panel **23** in units of one pixel line. The data driver **22** performs a display operation by applying the RGB signals to the selected pixel line of the display panel **23**. The timing signal generating block **11** transforms the data format of the inputted RGB data and outputs R data, G data, and B data. The D/A converting block **14** transforms the R data, G data, and B data outputted from the timing signal generating block **11** into analog signals, and then outputs the analog signals to the differential amplifying block **17**.

[0022] The reference data for brightness adjustment outputted from the memory **13** is inputted to the D/A converting block **15**, where it is transformed into analog signals. The analog signals outputted from the D/A converting block **15** are amplified in voltage level by the amplifying block **16**, and outputted to the (−) voltage terminal of the differential amplifying block **17**.

[0023] The differential amplifying block **17** includes three differential amplifiers **171**, **172**, and **173** for processing signals corresponding to each color of red, green, and blue, respectively. As described above, the RGB signals from the D/A converting block **14** are inputted to the differential amplifying block **17** while the reference signal for brightness adjustment of the red, green, and blue colors is inputted to the differential amplifying block **17**. Each of the differential amplifiers **171**, **172**, and **173** amplifies one corresponding color signal among the RGB signals. More particularly, each of the differential amplifiers **171**, **172**, and **173** receives an RGB analog signal and a reference signal for brightness adjustment and adjusts the white level of the corresponding color signal by using the received reference signal for brightness adjustment. As a result, the amplitude of the white level among the gray display levels, which is represented by the RGB analog signals, may be adjusted in accordance with the reference signal for brightness adjustment. **FIG. 2** illustrates a varying width of the white level. Through the above described procedure, the gamma component of the RGB analog signal may be adjusted in accordance with the average brightness value of a display screen. The differential amplifying block **17** generates RGB

signals having undergone gamma correction, and the RGB signals are provided to the data driver **22**. The data driver **22** applies the RGB signals to the display panel **23**.

[**0024**] In the image display apparatus described above, a driver of a voltage driving type has been used as the data driver **22**, but the technical range of the invention is not limited to this point. However, it should be understood by one of ordinary skill in the art that a driver of a current driving type may be used as the data driver **22**. In this case, the memory **13** in **FIG. 1** may be excluded and the output signal of the data operating block **12** is directly inputted to the D/A converting block **15**.

[**0025**] As described above, the image display apparatus of the invention may adjust amplitude of the white gray levels in accordance with average brightness of a screen displayed by RGB data. Thus, a problem of uneven display in a screen due to a brightness difference may be solved.

[**0026**] While this invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. An image display apparatus, comprising:

a display panel having pixels arranged in a matrix and for performing a display operation;

a scan driver for sequentially selecting pixel lines of the display panel;

a data driver for applying color signals to a corresponding pixel line when the pixel line of the display panel is selected; and

a display controller for receiving color data and generating timing signals for controlling the scan driver and the data driver, while transforming the color data into analog signals and performing gamma correction to the transformed analog signals to generate the color signals,

wherein the display controller determines reference data for brightness adjustment in accordance with an average brightness of a screen displayed by the RGB data, and performs gamma correction by adjusting gray levels of the RGB data in accordance with the reference data for brightness adjustment.

2. The image display apparatus according to claim 1, wherein the color signals are RGB signals, and the color data is RGB data.

3. The image display apparatus according to claim 2, wherein the RGB data inputted to the display controller are provided from a graphic controller of a mobile telephone or a PDA outside the image display apparatus.

4. The image display apparatus according to claim 2, wherein the display controller comprises:

a timing signal generating block for generating timing signals for controlling the scan driver and the data driver by using the received RGB data and transforming a data format of the RGB data;

a data operating block for calculating average brightness of a screen displayed by the received RGB data and outputting address information corresponding to the calculated average brightness;

a memory for storing reference data for brightness adjustment as data information corresponding to addresses, the reference data being matched with the calculated average brightness, and outputting reference data for brightness adjustment in response to the address information outputted from the data operating block;

a D/A converting means for transforming the RGB data outputted from the timing signal generating block and the reference data for brightness adjustment into analog signals;

an amplifying block for amplifying the analog signals of the reference data for brightness adjustment outputted from the D/A converting means; and

a differential amplifying block for controlling white level of the RGB data by using analog signals of the RGB data and the reference data for brightness adjustment and generating RGB signals.

5. The image display apparatus according to claim 4, wherein the reference data for brightness adjustment comprises of red color components, green color components, and blue color components.

6. The image display apparatus according to claim 4, wherein the reference data for brightness adjustment is set to be high when the average brightness of a screen has a high value and is set to be low when the average brightness of a screen has a low value.

7. The image display apparatus according to claim 4, wherein the differential amplifying block includes a differential amplifier for each of the red color component, green color component and blue color component and each of the differential amplifiers processes the color component associated therewith.

8. The image display apparatus according to claim 4, wherein the differential amplifying block adjusts the white level of the RGB signal by controlling the RGB signals with the analog signals of the reference data for brightness adjustment.

9. An image display apparatus, comprising:

a timing signal generating block for generating a timing signal for controlling a scan driver and a data driver by using inputted RGB data and transforming a data format of the inputted RGB data;

a data operating block for calculating an average brightness of a screen displayed by the inputted RGB data and outputting address information corresponding to the calculated average brightness;

a memory for storing reference data for brightness adjustment as data information corresponding to addresses, the reference data being matched with the calculated average brightness, and outputting reference data for brightness adjustment in response to the address information outputted from the data operating block;

a D/A converting means for transforming the RGB data outputted from the timing signal generating block and the reference data for brightness adjustment into analog signals;

an amplifying block for amplifying the analog signal of the reference data for brightness adjustment outputted from the D/A converting means; and

a differential amplifying block for controlling white level of the RGB data by using analog signals of the RGB data and the reference data for brightness adjustment and generating RGB signals.

10. The image display apparatus according to claim 9, wherein the reference data for brightness adjustment comprises red color components, green color components, and blue color components.

11. The image display apparatus according to claim 9, wherein the reference data for brightness adjustment is set to be high where the average brightness of a screen has a high value and is set to be low where the average brightness of a screen has a low value.

12. The image display apparatus according to claim 9, wherein the differential amplifying block includes a differential amplifiers for each color component.

13. The image display apparatus according to claim 12, where there is a red color component, a green color component and a blue color component.

14. The image display apparatus according to claim 9, wherein the differential amplifying block adjusts the white level of the RGB signal by controlling the RGB signal with the analog signal of the reference data for brightness adjustment.

15. A method for generating color signals for an image display apparatus, the method comprising:

receiving color data;

generating timing signals for controlling a scan driver and a data driver;

transforming the color data into analog signals;

determining reference data for brightness adjustment based on an average brightness of a screen displayed by the color data; and

performing gamma correction on the transformed analog signals to generate the color signals by adjusting gray levels of the color data based on the reference data for brightness adjustment.

16. The method according to claim 15, wherein the color data is RGB color data and the color signals are red color signals, blue color signals and green color signals.

17. The method according to claim 15, further comprising:

calculating an average brightness of a screen displayed by the received color data; and

outputting address information corresponding to the calculated average brightness.

18. The method according to claim 17, further comprising:

storing the reference data for brightness adjustment as data information corresponding to addresses, wherein the reference data is matched with the calculated average brightness.

* * * * *

专利名称(译)	图像显示装置		
公开(公告)号	US20040164938A1	公开(公告)日	2004-08-26
申请号	US10/734674	申请日	2003-12-15
申请(专利权)人(译)	三星SDI CO.，LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	CHOI JIN HYUN OH CHOON YUL LEE JAE SUNG		
发明人	CHOI, JIN-HYUN OH, CHOON-YUL LEE, JAE-SUNG		
IPC分类号	H05B33/12 G09F9/30 G09G3/00 G09G3/20 G09G3/30 G09G3/32 H01L51/50 H04N5/70 H05B33/00 H05B33/14		
CPC分类号	G09G3/3208 G09G3/3275 G09G2360/16 G09G2320/0271 G09G2320/0626 G09G2310/027		
优先权	1020030010665 2003-02-20 KR		
其他公开文献	US7304655		
外部链接	Espacenet USPTO		

摘要(译)

一种图像显示装置，具有像素，其中每个像素具有诸如有机EL（电致发光）元件的发光元件。发光元件的亮度由流入发光元件的电流控制。图像显示设备根据RGB数据显示的屏幕的平均亮度来调整白色灰度级的幅度。