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**(54) Display apparatus and control method thereof**

Anzeigevorrichtung und Steuerungsverfahren dafür

Appareil d'affichage et son procédé de commande

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## Description

**[0001]** Apparatuses and methods related to the exemplary embodiments disclosed herein pertain to a display apparatus and a control method thereof, and more particularly, to a display apparatus and a control method thereof which consumes less power without loss of brightness with respect to an image displayed by the display apparatus employing an organic light emitting diode.

**[0002]** Organic light emitting diode (OLED) displays include an organic layer as a light emitting material provided between an anode with holes and a cathode with electrons.

**[0003]** The OLED emits light by itself through re-combination of holes and electrons injected to the organic layer, and has a high brightness and a low driving voltage and can be made having an ultra-thin layer.

**[0004]** A conventional OLED display apparatus supplies a consistent or constant driving voltage to OLED pixels regardless of a change in gray scale, brightness, etc. in an input image. If an entire brightness of an image to be displayed is dark, a surplus voltage is generated as each OLED pixel requires a low current but has a consistent or constant driving voltage. The surplus voltage is consumed as heat, and wastes power consumption.

**[0005]** If an average picture level of an input image signal rises, power consumption of the OLED display apparatus increases proportionally. If the average picture level reaches a predetermined level or more, the OLED display apparatus maintains a consistent or constant power consumption level rather than consuming more power in proportion to the average picture level.

**[0006]** Additional aspects and/or advantages will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the invention.

**[0007]** Accordingly, one or more exemplary embodiments provide a display apparatus and a control method thereof which consumes less power by using light emitting and power consumption characteristics of the OLED.

**[0008]** EP2151814 discloses an organic LED display which has an adjustment unit that adjusts the actual duty and gain of video signal. The driving signal is increased in line with the reduction in the duty ratio (i.e. luminous time of the OLEDs during a frame) to keep the luminance constant.

**[0009]** The foregoing and/or other aspects may be achieved by providing a display apparatus according to claim 1.

**[0010]** The foregoing and/or other aspects may be achieved by providing a control method of a display apparatus according to claim 6.

**[0011]** The above and/or other aspects will become apparent and more readily appreciated from the following description of the exemplary embodiments, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a block diagram of a display apparatus according to an embodiment;

FIG. 2 is a block diagram of a brightness compensating unit according to the embodiment;

FIG. 3 illustrates a correlation between an average picture level and power consumption of an OLED display apparatus;

FIG. 4 illustrates an example of a histogram of an input image signal according to the embodiment; and  
FIG. 5 is a flowchart showing a control method of the display apparatus according to the embodiment.

**[0012]** Below, exemplary embodiments will be described in detail with reference to accompanying drawings so as to be easily realized by a person having ordinary knowledge in the art. The exemplary embodiments may be embodied in various forms without being limited to the exemplary embodiments set forth herein. Descriptions of well-known parts are omitted for clarity, and like reference numerals refer to like elements throughout.

**[0013]** FIG. 1 is a block diagram of a display apparatus 100 according to an embodiment. FIG. 2 is a block diagram of a brightness compensating unit.

**[0014]** As shown in FIG. 1, the display apparatus 100 may include a signal input unit (not shown) which receives at least one image signal, an image processor 110 which processes an image signal transmitted through the signal input unit, a display unit 120 which displays an image thereon based on an image signal processed by the image processor 110, a power supply 130 which supplies power to the display unit 120, a storage unit 160 which stores therein data and/or information, and a controller 140 which controls overall elements of the display apparatus 100.

**[0015]** The signal input unit transmits the received image signal to the image processor 110, and varies depending on a standard of a received signal or embodiment type of an image supply source and the display apparatus 100. For example, the signal input unit may receive signals and/or data according to standards such as high definition multimedia interface (HDMI), universal serial bus (USB), Component, S-video, digital video interface (DVI), etc., and includes a plurality of connection terminals (not shown) corresponding to the foregoing standards.

**[0016]** The signal input unit receives a broadcasting signal input an image signal from a broadcasting station, satellite, etc., and may include a tuner to tune a channel of a received broadcasting signal.

**[0017]** The image processor 110 processes an image signal transmitted by the signal input unit, according to various preset image processing operations. The image processor 110 outputs the processed image signal to the display unit 120, on which an image may be displayed on the basis of the processed image signal.

**[0018]** The image processing operation of the image processor 110 may include, but is not limited to, a demultiplexing operation for dividing a predetermined sig-

nal into a predetermined number of signals, a decoding operation corresponding to an image format of an image signal, a de-interlacing operation for converting an interlace image signal into a progressive image signal, a scaling operation for adjusting an image signal into a preset resolution, a noise reduction operation for improving an image quality, a detail enhancement operation, a frame refresh rate conversion, etc.

**[0019]** The image processor 110 may include a brightness compensating unit 150 which increases a brightness of an input image signal as will be described later.

**[0020]** The display unit 120 displays an image thereon based on an image signal output by the image processor 110, and is implemented as an organic light emitting diode (OLED) display.

**[0021]** A display panel (not shown) of the display unit 120 may include a plurality of pixels arranged in a matrix consisting of rows and columns. The plurality of pixels may include an OLED and a cell driver which independently drives the OLED.

**[0022]** The power supply 130 supplies power to the display panel of the display unit 120 according to a control signal of the controller 140 which will be described later. The power supply 130 in FIG. 1 is separately provided from the display unit 120, but is not limited thereto. Alternatively, the power supply 130 according to the embodiment may be included in the display unit 120.

**[0023]** The storage unit 160 stores therein a compensation coefficient for compensating for a gray scale of an input image which will be described later, and a duty value corresponding to the compensation coefficient, as a lookup table. The storage unit may be accessed by the controller 140 and the data stored in the storage unit may be read, written, amended, deleted, and/or updated by the controller 140. The storage unit 160 may be installed in the controller 140 as shown in FIG. 1 for example, or may be provided separately, for example as an external memory. The storage 160, which may store one or more of the lookup tables disclosed herein, may be realized for example, by a non-volatile memory device such as a read only memory (ROM), a random access memory (RAM), a programmable read only memory (PROM), an erasable programmable read only memory (EPROM), or a flash memory, a volatile memory device such as a random access memory (RAM), or a storage medium such as a hard disk or optical disk. However, the present invention is not limited thereto.

**[0024]** The controller 140 controls the image processor 110 and/or the brightness compensating unit 150 to compensate for a gray scale of an input image, and controls the power supply 130 to reduce the power supply corresponding to the brightness increased as a result of the compensated gray scale. The controller may use one or more processors to perform its respective functions.

**[0025]** The brightness compensating unit 150 includes an average picture level (APL) extractor 151 which extracts an APL of an input image, a histogram calculator 153, a maximum gray scale extractor 155 which extracts

a maximum gray scale from the calculated histogram, and a compensation processor 157 which compensates for a gray scale of an input image so that the extracted maximum gray scale corresponds to a predetermined gray scale value.

**[0026]** As shown in FIG. 1, the brightness compensating unit 150 may be included in the image processor 110 or may be separately provided from the image processor 110.

**[0027]** The APL extractor 151 extracts an APL of an input image signal by frame. That is, for each frame of the input image signal, an APL may be extracted by the APL extractor 151. However, the disclosure is not limited thereto. For example, the APL extractor 151 may extract an APL according to a set frequency (e.g., extracting an APL of a frame for every "X" number of frames of the input image signal, for example, extracting an APL of a frame every other frame). The APL refers to an average value of a brightness level of an input image signal to be displayed in each of a plurality of pixels included in the display unit 120.

**[0028]** The controller 140 determines whether the APL extracted from the input image signal is a predetermined value or more. If it is determined that the APL is less than the predetermined value, the controller 140 outputs the image signal to the display unit 120 rather than compensating for the gray scale of the input image signal. That is, if the APL is less than a predetermined threshold value, the controller 140 outputs the image signal to the display unit 120 without compensating for the gray scale of the input image signal. If it is determined that the APL is the predetermined value or more, the controller 140 controls the histogram calculator 153 to calculate a histogram of the input image. That is, if the APL is equal to or greater than a predetermined threshold value, the controller 140 may perform a compensation operation on the input image signal.

**[0029]** FIG. 3 illustrates a correlation between the APL of the OLED display apparatus and power consumption. Due to the nature of the OLED display apparatus, if the APL is low, the OLED display apparatus consumes more power in proportion to the APL. That is, for an APL between a first value and a threshold value T, as the APL increases, power consumption increases in a proportionate manner. If the APL is a predetermined value or more, the OLED display apparatus consume power consistently or at a substantially constant rate rather than consuming more power in proportion to the APL. That is, for an APL equal to or greater than the threshold value T, as the APL increases, power consumption remains at a relatively or substantially constant level.

**[0030]** As shown in FIG. 3, the predetermined value corresponds to an APL having a threshold value T. In proportion to the increase in the APL, the power consumption increases, and if the APL increases further and reaches the predetermined value, the power consumption does not increase in proportion to the APL.

**[0031]** FIG. 4 illustrates an example of a histogram with

respect to an input image signal of a single frame that is calculated by the histogram calculator 153.

**[0032]** A horizontal axis of the histogram in FIG. 4 refers to a gray scale value, and e.g., a gray scale value of 1024 when the input image signal is based on 10 bits. However, the disclosure is not so limited and the gray scale value may correspond to another value according to the number of shades of gray and corresponding bits which are desired to be represented in the image signal. A vertical axis of the histogram refers to the frequency of a gray scale value corresponding to each of a plurality of pixels included in the display panel. For example, 5% frequency of 300 gray scale means that the number of pixels representing 300 gray scale is 5% of the total number of pixels. Here, the total number of pixels may refer to all of the pixels in the frame. Alternatively, a subset or sample of all of the pixels in the frame may be used instead of all of the pixels in the frame. Thus, the histogram may be developed based on a representative portion of all of the pixels in the frame and a maximum gray scale value M (described below) may be extracted from the representative portion of all of the pixels in the frame.

**[0033]** The maximum gray scale extractor 155 extracts a maximum gray scale from the histogram calculated by the histogram calculator 153. For example, the maximum gray scale extractor 155 extracts a maximum gray scale M of the histogram shown in FIG. 4.

**[0034]** The controller 140 determines whether the extracted maximum gray scale is a predetermined gray scale value or more. For example, referring to FIG. 4, if a predetermined gray scale value is set as 1024, the controller 140 determines whether the extracted maximum gray scale M is 1024 or more.

**[0035]** The predetermined gray scale value may be set as a peak gray scale of an input image, e.g., as 1024 gray scale when the input image signal is based on 10 bits, but the disclosure is not limited thereto. Alternatively, the predetermined gray scale value may be set as a lower gray scale than the peak gray scale, e.g., 512 or 1000.

**[0036]** If the extracted maximum gray scale M is smaller than 1024 gray scale when 1024 gray scale is set as the predetermined gray scale value, the controller 140 controls the compensation processor 157 to compensate for the gray scale of the input image signal.

**[0037]** The storage unit stores in advance therein a compensation coefficient as a lookup table to compensate for the gray scale of the input image signal. The compensation coefficient is a preset predetermined gray scale value, e.g. the compensation coefficient may be a value calculated by dividing the preset peak gray scale (e.g., 1024 gray scale) by the extracted maximum gray scale M. That is, the compensation coefficient refers to a compensation gain that may increase the gray scale value of the maximum gray scale M up to the preset peak gray scale (e.g., 1024 gray scale) by multiplying the maximum gray scale M by the compensation coefficient. For example, if the maximum gray scale M is 800 gray scale and the preset peak gray scale is 1024 gray scale, then

the compensation coefficient may be calculated by dividing 1024 by 800 which is about 1.28 and this value may be referred to as a compensation gain.

**[0038]** The controller 140 determines a compensation coefficient corresponding to the maximum gray scale of the input image by referring to the lookup table stored in the storage unit.

**[0039]** Based on the determined compensation coefficient, the compensation processor 157 compensates for a gray scale of a plurality of pixels of the input image signal, and outputs to the display unit 120 image data whose gray scale has been increased as a whole. For example, according to the above-described example, the compensation processor 157 may compensate for a gray scale of a plurality of pixels of the input image signal by applying the compensation gain to the plurality of pixels (e.g., by increasing the image data gray scale values for each of the pixels by about 1.28 times).

**[0040]** Accordingly, the image data output to the display unit 120 has a higher brightness than the brightness of the input image signal.

**[0041]** The storage unit stores in advance therein a duty value as a lookup table corresponding to the compensation coefficient to compensate for the gray scale of the input image signal. The duty value refers to a power duty value which is used to display the image data with the increased brightness by the compensation for the gray scale, in the same brightness as the input image, i.e., that reduces the brightness of the image data. The duty value corresponds to each compensation coefficient. The higher the compensation coefficient is, the lower the duty value for reducing the brightness is.

**[0042]** The controller 140 determines a duty value corresponding to the compensation coefficient of the input image by referring to the lookup table stored in the storage unit, and controls the power supply 130 to supply power corresponding to the determined duty value, i.e. with a lower duty value.

**[0043]** The power supply 130 may include a duty value controller (not shown), which supplies power with the determined duty value corresponding to a control signal of the controller 140. Otherwise, a pulse width modulation (PWM) generator (not shown) may be additionally provided to generate a PWM signal corresponding to the duty value determined by the controller 140. The power supply 130 may receive the PWM signal and accordingly adjust an output voltage level.

**[0044]** Accordingly, the duty value may be reduced corresponding to the brightness that is increased as a result of the compensation for the gray scale of the image to display the input image in the same brightness, and power consumption may be reduced by the reduced duty value.

**[0045]** Hereinafter, a control method of the display apparatus according to the embodiment will be described with reference to FIG. 5.

**[0046]** As shown therein, the controller 140 controls the image processor 110 and/or the brightness compen-

sating unit 150 to extract an APL for a frame of the input image signal. The controller 140 determines whether the extracted APL is a predetermined value or more (S500). If it is determined that the extracted APL is less than the predetermined value, the controller 140 outputs the image signal to the display unit 120 rather than compensating for the gray scale of the input image signal. If it is determined that the extracted APL is equal to the predetermined value or more, the controller 140 compensates for the gray scale of the input image to increase the brightness of the input image (S510).

**[0047]** The operation of compensating for the gray scale of the input image may include an operation of extracting the APL of the input image, an operation of calculating the histogram of the input image, an operation of extracting the maximum gray scale of the calculated histogram, and an operation of compensating for the gray scale of the input image based on the compensation coefficient which is set so that the extracted maximum gray scale corresponds to the predetermined gray scale value.

**[0048]** The compensation gray scale may be stored in advance as a lookup table in the storage unit and may be provided so that the maximum gray scale of the input image corresponds to the preset predetermined gray scale value.

**[0049]** The controller 140 reduces the power supply corresponding to the brightness that has been increased as a result of the compensated gray scale (S520). That is, the controller 140 determines the duty value corresponding to the compensated gray scale, and reduces the power supply based on the determined duty value.

**[0050]** The duty value may be stored in advance as a lookup table in the storage unit, and may be provided so that the brightness of the image displayed on the display unit is the same as a brightness of the input image before the compensation for the gray scale.

**[0051]** As described above, a display apparatus and a control method thereof according to an embodiment may consume less power by using light emitting and power consumption characteristics of the OLED. In one example, an average picture level (APL) of an input image is compared with a predetermined threshold value, and an image processor is controlled to compensate for a gray scale of the input image to thereby increase a brightness of the input image based on a result of the comparison. The average picture level may refer to an average value of a brightness level of an input image signal. However, in alternative embodiments other statistical measures may be implemented. For example, a median picture level may refer to a median value of a brightness level of an input image signal, and the median picture level may be compared with another predetermined threshold value to determine whether gray scale compensation should be performed to increase a brightness of the input image.

**[0052]** As mentioned above, the APL may refer to an average value of a brightness level of an input image signal, which may be calculated based upon the brightness level of each of the plurality of pixels displayed by

the display. Alternatively, the average value of a brightness level of an input image signal may be calculated based upon the brightness level of a representative portion of pixels displayed by the display, i.e., a subset of the total number of pixels of the display.

**[0053]** The display apparatus and control methods according to the above-described example embodiments may use one or more processors, which may include a microprocessor, central processing unit (CPU), digital signal processor (DSP), or application-specific integrated circuit (ASIC), as well as portions or combinations of these and other processing devices.

**[0054]** The terms "module", and "unit," as used herein, may refer to, but are not limited to, a software or hardware component or device, such as a Field Programmable Gate Array (FPGA) or Application Specific Integrated Circuit (ASIC), which performs certain tasks.

**[0055]** A module or unit may be configured to reside on an addressable storage medium and configured to execute on one or more processors. Thus, a module or unit may include, by way of example, components, such as software components, object-oriented software components, class components and task components, processes, functions, attributes, procedures, subroutines, segments of program code, drivers, firmware, microcode, circuitry, data, databases, data structures, tables, arrays, and variables. The functionality provided for in the components and modules/units may be combined into fewer components and modules/units or further separated into additional components and modules.

**[0056]** Each block of the flowchart illustrations may represent a unit, module, segment, or portion of code, which comprises one or more executable instructions for implementing the specified logical function(s). It should also be noted that in some alternative implementations, the functions noted in the blocks may occur out of the order. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved.

**[0057]** The apparatus and methods according to the above-described embodiments may be recorded in non-transitory computer-readable media including program instructions to implement various operations embodied by a computer. The media may also include, alone or in combination with the program instructions, data files, data structures, and the like. Examples of non-transitory computer-readable media include magnetic media such as hard disks, floppy disks, and magnetic tape; optical media such as CD ROM disks and DVDs; magneto-optical media such as optical discs; and hardware devices that are specially configured to store and perform program instructions, such as read-only memory (ROM), random access memory (RAM), flash memory, and the like.

**[0058]** Examples of program instructions include both machine code, such as produced by a compiler, and files containing higher level code that may be executed by the

computer using an interpreter. The described hardware devices may be configured to act as one or more software modules in order to perform the operations of the above-described embodiments, or vice versa. In addition, a non-transitory computer-readable storage medium may be distributed among computer systems connected through a network and computer-readable codes or program instructions may be stored and executed in a decentralized manner. In addition, the computer-readable storage media may also be embodied in at least one application specific integrated circuit (ASIC) or Field Programmable Gate Array (FPGA).

**[0059]** Although a few exemplary embodiments have been shown and described, it will be appreciated by those skilled in the art that changes may be made to these exemplary embodiments without departing from the principles of the invention, the scope of which is defined in the appended claims.

**Claims**

**1.** A display apparatus (100) comprising:

- a display unit (120) which comprises a plurality of pixels having an organic light emitting diode (OLED);
- a power supply (130) arranged to supply power to the display unit;
- an image processor (110) comprising a brightness compensating unit (150) arranged to process an input image to display an image on the display unit (120), wherein the brightness compensating unit (150) comprises an APL extractor (151) arranged to extract an APL of the input image, a histogram calculator (153), a maximum gray scale extractor (155) and a compensation processor (157); and
- a controller (140) arranged to determine whether an average picture level, APL, of the input image is greater than or equal to a predetermined value, and, if the extracted APL value is greater than or equal to the predetermined value,

- to control the histogram calculator (153) to calculate a histogram of the input image;
- to control the maximum gray scale extractor (155) to extract a maximum gray scale of the calculated histogram; and
- to control the compensation processor (157) to compensate for the gray scales of the input image based on a compensation coefficient that is set so that the extracted maximum gray scale becomes equal to a predetermined gray scale value after compensation for the gray scales to thereby increase a brightness of the input image, and

to control the power supply (130) to reduce the power supplied to the display unit (120) in correspondence with the increase of brightness caused by the compensated gray scales such that a brightness of an image displayed on the display unit after compensating the gray scales is the same as the brightness of the input image before compensating the gray scales, and, if the extracted APL value is less than the predetermined value, to output the input image to the display unit without compensating the gray scales.

**2.** The display apparatus (100) according to claim 1, wherein the controller (140) is arranged to determine a duty value corresponding to the compensated gray scales, and to reduce the power supply based on the determined duty value.

**3.** The display apparatus (100) according to claim 1 or 2, further comprising a storage unit arranged to store compensation coefficients for compensating for the gray scales of the input image and to store a duty value corresponding to each compensation coefficient, using a lookup table.

**4.** The display apparatus (100) according to claim 3, wherein the compensation coefficient is calculated so that a maximum gray scale of the input image becomes equal to a preset predetermined gray scale value after compensating for the gray scales of the input image.

**5.** A method of control of the display apparatus of claim 1 comprising:

- extracting the APL of the input image;
- determining whether an average picture level, APL, of an input image is greater than or equal to a predetermined value;
- if the extracted APL value is greater than or equal to the predetermined value,
- calculating a histogram of the input image;
- extracting a maximum gray scale of the calculated histogram; and
- compensating for the gray scales of the input image based on the compensation coefficient which is set so that the extracted maximum gray scale becomes equal to a predetermined gray scale value after compensation for the gray scales to thereby increase a brightness of the input image, and reducing the supply power in correspondence with the increase of brightness caused by the compensated gray scales such that a brightness of an image displayed on the display unit after compensating the gray scales is the same as brightness of the input image

before compensating the gray scales, and, if the extracted APL value is less than the predetermined value, outputting the input image to the display unit without compensating the gray scales.

6. The control method according to claim 5, wherein the reducing the power supply comprises determining a duty value corresponding to the compensated gray scales and reducing the power supply base on the determined duty value.
7. The control method according to claim 5 or 6, wherein the compensating for the gray scales of the input image comprises referring to a compensation coefficient for compensating for the gray scales of the input image that is stored in advance in a lookup table stored in a storage unit.
8. The control method according to claim 7, wherein the reducing the power supply comprises referring to a duty value corresponding to the compensation coefficient that is stored in advance in the lookup table stored in the storage unit.
9. The control method according to claim 7 or 8, wherein the compensation coefficient is calculated so that a maximum gray scale of the input image becomes equal to a preset predetermined gray scale value.

#### Patentansprüche

1. Anzeigevorrichtung (100), die Folgendes umfasst:

eine Anzeigeeinheit (120), die eine Vielzahl von Pixeln umfasst, die eine organische Leuchtdiode (OLED) aufweist;  
 eine Leistungsversorgung (130), die dazu angeordnet ist, der Anzeigeeinheit Leistung zu liefern;  
 einen eine Helligkeitsausgleichseinheit (150) umfassenden Bildprozessor (110), der dazu angeordnet ist, ein Eingabebild zu verarbeiten, um ein Bild auf der Anzeigeeinheit (120) anzuzeigen, wobei die Helligkeitsausgleichseinheit (150) Folgendes umfasst: einen APL-Extraktor (151), der dazu angeordnet ist, einen APL des Eingabebilds auszuziehen, eine Histogramm-Berechnungseinrichtung (153), einen Extraktor (155) für die maximale Graustufe und einen Ausgleichsprozessor (157); und  
 einen Controller (140), der dazu angeordnet ist, festzustellen, ob ein mittlerer Bildpegel, APL, des Eingabebilds größer als oder gleich einem vorherbestimmten Wert ist und, wenn der ausgezogene APL-Wert größer als oder gleich dem vorherbestimmten Wert ist,

die Histogramm-Berechnungseinrichtung (153) dazu zu steuern, ein Histogramm des Eingabebilds zu berechnen; den Extraktor (155) für die maximale Graustufe dazu zu steuern, eine maximale Graustufe des berechneten Histogramms auszuziehen; und  
 den Ausgleichsprozessor (157) dazu zu steuern, die Graustufen des Eingabebilds basierend auf einem Ausgleichskoeffizienten auszugleichen, der derart eingestellt ist, dass die ausgezogene maximale Graustufe nach dem Ausgleichen der Graustufen gleich einem vorherbestimmten Graustufenwert wird, um dadurch eine Helligkeit des Eingabebilds zu erhöhen, und die Leistungsversorgung (130) dazu zu steuern, die an die Anzeigeeinheit (120) gelieferte Leistung in Entsprechung mit der durch die ausgeglichenen Graustufen verursachten Erhöhung der Helligkeit zu senken, sodass eine Helligkeit eines auf der Anzeigeeinheit angezeigten Bilds nach dem Ausgleichen der Graustufen dieselbe ist, wie die Helligkeit des Eingabebilds vor dem Ausgleichen der Graustufen und, wenn der ausgezogene APL-Wert geringer ist als der vorherbestimmte Wert, das Eingabebild an die Anzeigeeinheit auszugeben, ohne die Graustufen auszugleichen.

2. Anzeigevorrichtung (100) nach Anspruch 1, wobei der Controller (140) dazu angeordnet ist, einen den ausgeglichen Graustufen entsprechenden Auslastungswert zu bestimmen und die Leistungsversorgung basierend auf dem bestimmten Auslastungswert zu senken.

3. Anzeigevorrichtung (100) nach Anspruch 1 oder 2, weiter umfassend eine Speichereinheit, die dazu angeordnet ist, Ausgleichskoeffizienten zum Ausgleichen der Graustufen des Eingabebilds zu speichern und unter Verwendung einer Nachschlagtabelle zu jedem Ausgleichskoeffizienten einen entsprechenden Auslastungswert zu speichern.

4. Anzeigevorrichtung (100) nach Anspruch 3, wobei der Ausgleichskoeffizient derart berechnet wird, dass eine maximale Graustufe des Eingabebilds nach dem Ausgleichen der Graustufen des Eingabebilds, gleich einem voreingestellten vorherbestimmten Graustufenwert wird.

5. Verfahren zum Steuern der Anzeigevorrichtung nach Anspruch 1, das Folgendes umfasst:

Ausziehen des APL des Eingabebilds;  
 Bestimmen, ob ein mittlerer Bildpegel, APL, eines Eingabebildes größer als oder gleich einem vorherbestimmten Wert ist;  
 wenn der ausgezogene APL-Wert größer als

oder gleich dem vorherbestimmten Wert ist:

- Berechnen eines Histogramms des Eingabebilds;  
 Ausziehen einer maximalen Graustufe des berechneten Histogramms; und  
 Ausgleichen der Graustufen des Eingabebilds basierend auf dem Ausgleichskoeffizienten, der derart eingestellt ist, dass die ausgezogene maximale Graustufe nach dem Ausgleichen der Graustufen gleich einem vorherbestimmten Graustufenwert wird, um dadurch eine Helligkeit des Eingabebilds zu erhöhen und Senken der Zufuhrleistung in Entsprechung mit der Erhöhung der durch die ausgeglichenen Graustufen verursachten Erhöhung der Helligkeit, so dass eine Helligkeit eines auf der Anzeigeeinheit angezeigten Bilds nach dem Ausgleichen der Graustufen dieselbe ist, wie die Helligkeit des Eingabebilds vor dem Ausgleichen der Graustufen und, wenn der ausgezogene APL-Wert geringer ist als der vorherbestimmte Wert, Ausgeben des Eingabebilds an die Anzeigeeinheit, ohne die Graustufen auszugleichen.
6. Steuerverfahren nach Anspruch 2, wobei das Senken der Leistungsversorgung das Bestimmen eines den ausgeglichenen Graustufen entsprechenden Auslastungswerts und das Senken der Leistungsversorgung basierend auf dem bestimmten Auslastungswert umfasst.
7. Steuerverfahren nach Anspruch 5 oder 6, wobei das Ausgleichen der Graustufen des Eingabebilds das Verweisen auf einen Ausgleichskoeffizienten zum Ausgleichen der Graustufen des Eingabebilds umfasst, der im Voraus in einer in einer Speichereinheit gespeicherten Nachschlagtabelle gespeichert wird.
8. Steuerverfahren nach Anspruch 7, wobei das Senken der Leistungsversorgung das Verweisen auf einen Auslastungswert umfasst, der dem Ausgleichskoeffizienten entspricht, der im Voraus in der in der Speichereinheit gespeicherten Nachschlagtabelle gespeichert wird.
9. Steuerverfahren nach Anspruch 7 oder 8, wobei der Ausgleichskoeffizient derart berechnet wird, dass eine maximale Graustufe des Eingabebilds gleich einem voreingestellten vorherbestimmten Graustufenwert wird.

## Revendications

1. Appareil d'affichage (100) comprenant :

une unité d'affichage (120), comprenant une pluralité de pixels, qui possède une diode électroluminescente organique (DELO) ;  
 une alimentation électrique (130) adaptée pour fournir de l'énergie à l'unité d'affichage ;  
 un processeur d'images (110), comprenant une unité de compensation de luminosité (150), qui est adapté pour traiter une image d'entrée afin d'afficher une image sur l'unité d'affichage (120), l'unité de compensation de luminosité (150) comprenant un extracteur de NML (151) adapté pour extraire un NML de l'image d'entrée, un calculateur d'histogrammes (153), un extracteur d'échelle de gris maximale (155) et un processeur de compensation (157) ; et  
 un contrôleur (140) adapté pour déterminer si un niveau moyen de luminosité, NML, de l'image d'entrée est supérieur ou égal à une valeur prédéterminée et si la valeur NML extraite est supérieure ou égale à la valeur NML prédéterminée, pour commander le calculateur d'histogrammes (153) afin de calculer un histogramme de l'image d'entrée ;  
 pour commander l'extracteur d'échelle de gris maximale (155) afin d'extraire une échelle de gris maximale de l'histogramme calculé ; et  
 pour commander le processeur de compensation (157) afin de compenser les échelles de gris de l'image d'entrée sur la base d'un coefficient de compensation qui est fixé de façon que l'échelle de gris maximale extraite devienne égale à une valeur de l'échelle de gris prédéterminée après compensation des échelles de gris afin d'augmenter ainsi la luminosité de l'image d'entrée, et  
 pour commander l'alimentation électrique (130) afin de réduire l'énergie fournie à l'unité d'affichage (120), en fonction de l'augmentation de luminosité provoquée par les échelles de gris compensées de telle façon que la luminosité d'une image affichée sur l'unité d'affichage après la compensation des échelles de gris est identique à la luminosité de l'image d'entrée avant la compensation des échelles de gris et, si la valeur NML extraite est inférieure à la valeur prédéterminée, pour sortir l'image d'entrée sur l'unité d'affichage sans compensation des échelles de gris.

2. Appareil d'affichage (100) selon la revendication 1, dans lequel le contrôleur (140) est adapté pour déterminer une valeur de service correspondant aux échelles de gris compensées et pour réduire l'alimentation électrique en fonction de la valeur de service déterminée.
3. Appareil d'affichage (100) selon la revendication 1 ou la revendication 2, comprenant en outre une unité

de stockage adaptée pour stocker des coefficients de compensation afin de compenser les échelles de gris de l'image d'entrée et pour stocker une valeur de service correspondant à chaque coefficient de compensation en utilisant une table de consultation.

4. Appareil d'affichage (100) selon la revendication 3, dans lequel le coefficient de compensation est calculé de façon qu'une échelle de gris maximale de l'image d'entrée devienne égale à une valeur de l'échelle de gris prédéterminée préréglée après la compensation des échelles de gris de l'image d'entrée. 5
5. Procédé de commande de l'appareil d'affichage selon la revendication 1, comprenant les étapes consistant à : 10

extraire le NML de l'image d'entrée ;  
détecter si un niveau moyen de luminosité, NML, d'une image d'entrée est supérieur ou égal à une valeur prédéterminée ;  
si la valeur NML extraite est supérieure ou égale à la valeur prédéterminée,  
calculer un histogramme de l'image d'entrée ;  
extraire une échelle de gris maximale de l'histogramme calculé ; et  
compenser les échelles de gris de l'image d'entrée en fonction du coefficient de compensation, fixé de façon que l'échelle de gris maximale extraite devienne égale à une valeur de l'échelle de gris prédéterminée après compensation des échelles de gris, afin d'augmenter ainsi la luminosité de l'image d'entrée et de réduire l'alimentation électrique en fonction de l'augmentation de la luminosité provoquée par les échelles de gris compensées, de telle façon qu'une luminosité d'une image affichée sur l'unité d'affichage après la compensation des échelles de gris est identique à la luminosité de l'image d'entrée avant la compensation des échelles de gris et, si la valeur NML extraite est inférieure à la valeur prédéterminée, sortir l'image d'entrée sur l'unité d'affichage sans compensation des échelles de gris. 20  
25  
30  
35  
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6. Procédé de commande selon la revendication 5, dans lequel la réduction de l'alimentation électrique comprend la détermination d'une valeur de service correspondant aux échelles de gris compensées et la réduction de l'alimentation électrique est basée sur la valeur de service déterminée. 50
7. Procédé de commande selon la revendication 5 ou la revendication 6, dans lequel la compensation des échelles de gris de l'image d'entrée comprend le recours à un coefficient de compensation pour compenser les échelles de gris de l'image d'entrée qui 55

est stocké à l'avance dans une table de consultation stockée dans une unité de stockage.

8. Procédé de commande selon la revendication 7, dans lequel la réduction de l'alimentation électrique comprend le recours à une valeur de service correspondant au coefficient de compensation qui est stocké à l'avance dans la table de consultation stockée dans l'unité de stockage.
9. Procédé de commande selon la revendication 7 ou la revendication 8, dans lequel le coefficient de compensation est calculé de façon qu'une échelle de gris maximale de l'image d'entrée devienne égale à une valeur de l'échelle de gris prédéterminée préréglée.

FIG. 1

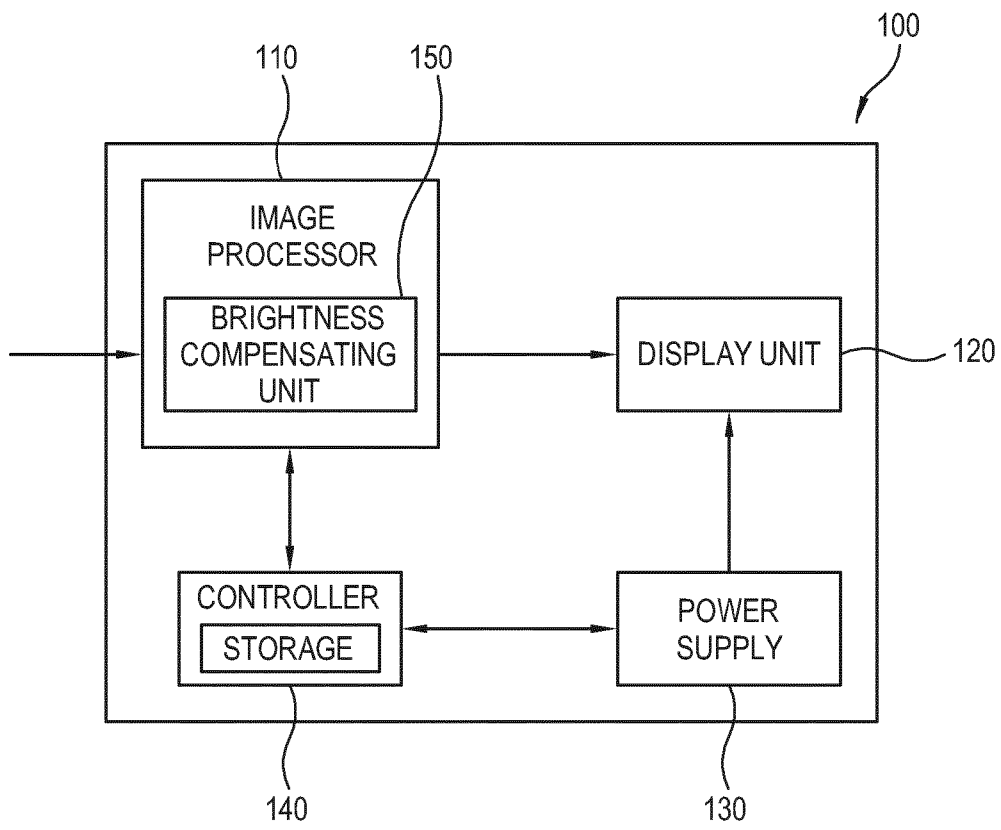


FIG. 2

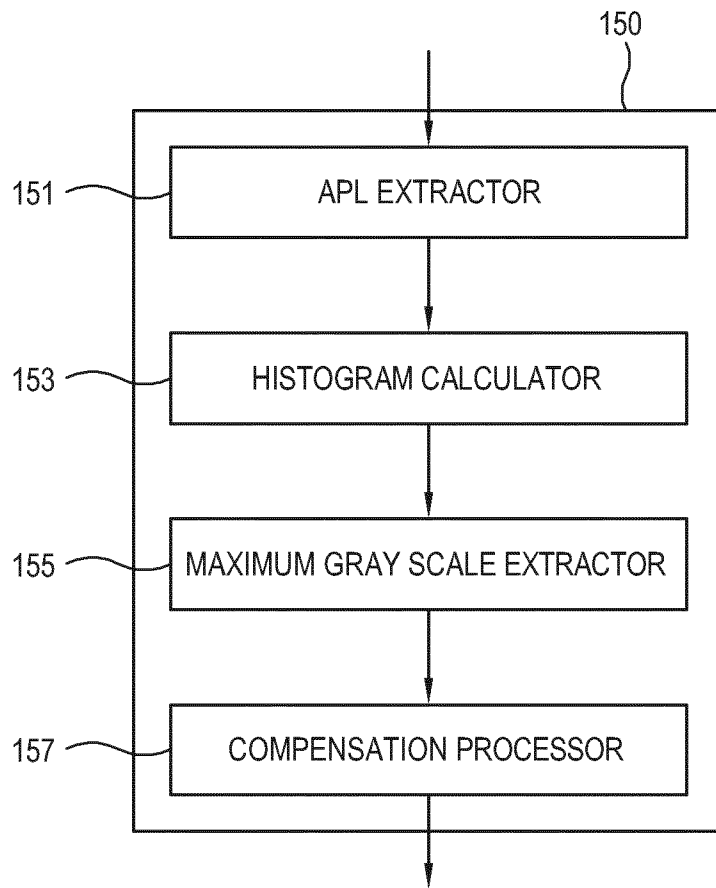


FIG. 3

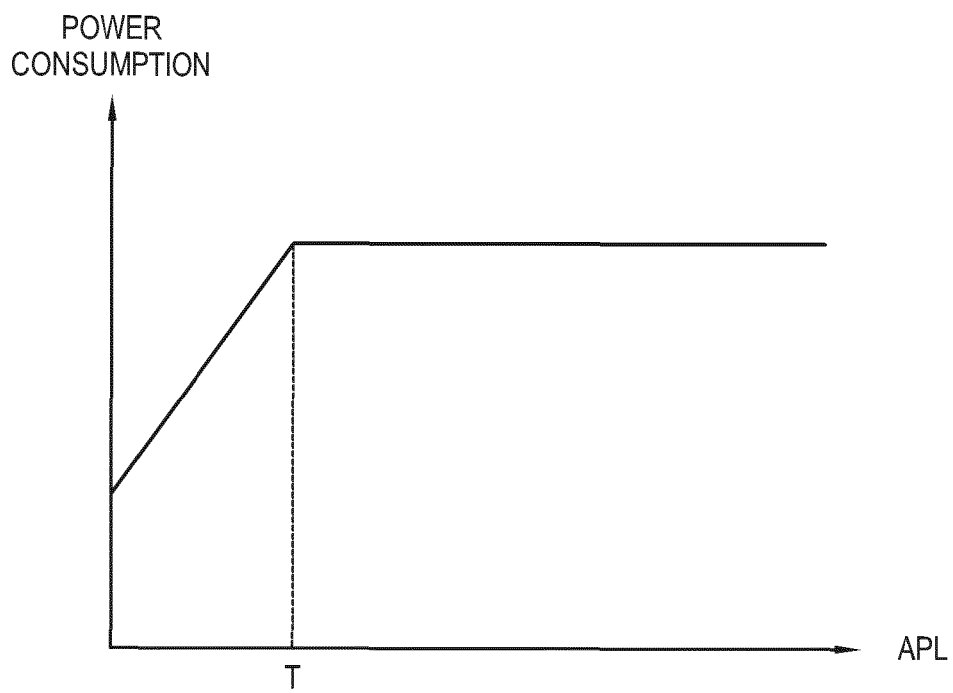


FIG. 4

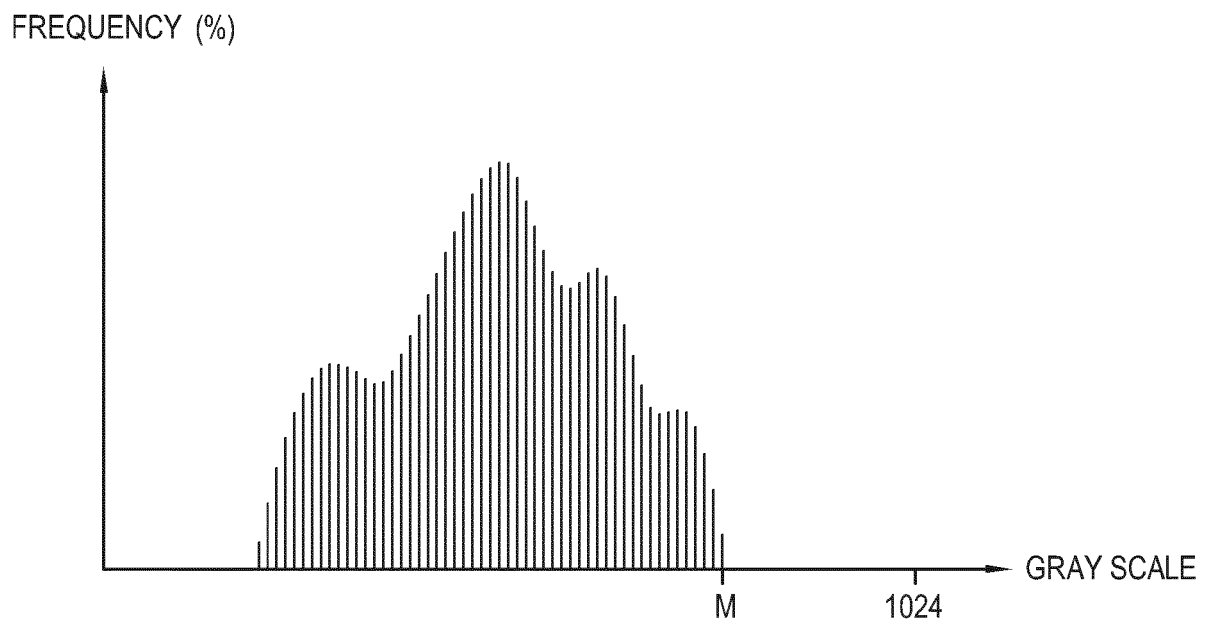
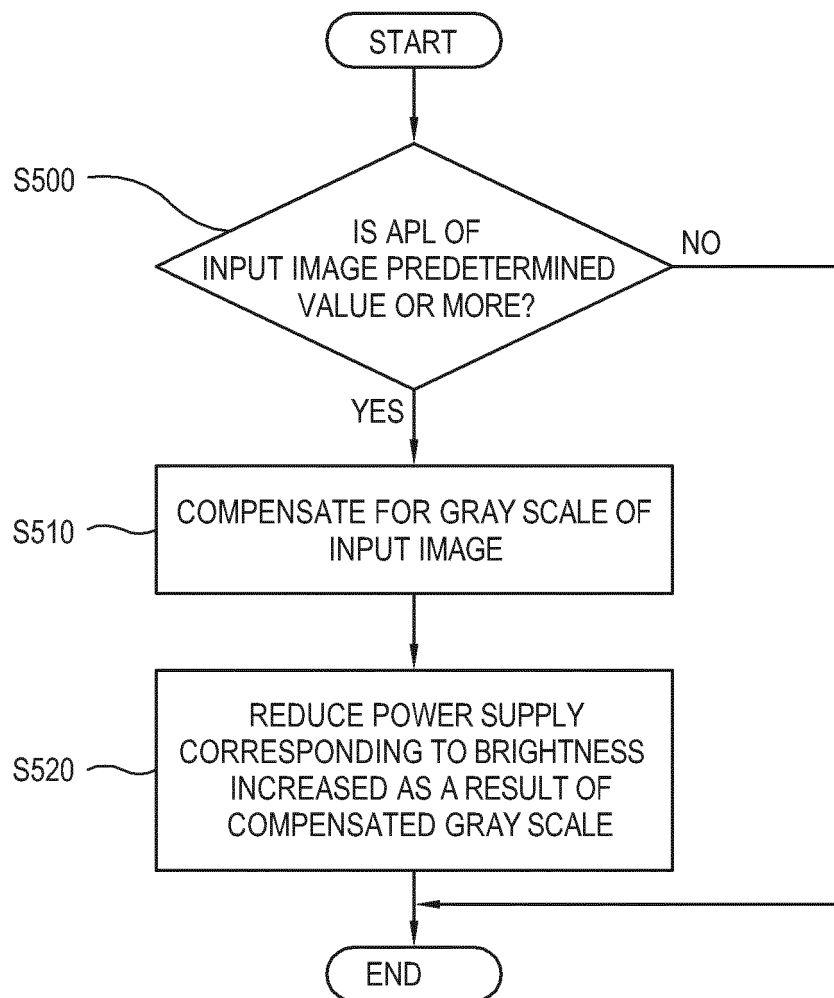


FIG. 5



**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- EP 2151814 A [0008]

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摘要(译)

一种显示装置，包括：显示单元，包括具有有机发光二极管（OLED）的多个像素；向显示单元供电的电源；处理输入图像以在显示单元上显示图像的图像处理器和控制器，其确定输入图像的平均图像电平（APL）是否是预定值或更大。基于APL值，控制器控制图像处理器以补偿输入图像的灰度级，从而增加输入图像的亮度，并控制电源以减少与亮度增加相对应的电源。补偿灰度。

FIG. 1

