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(54) **DISPLAY DEVICE AND GAMMA VOLTAGE SETTING METHOD THEREOF**

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G09G 3/20 (2006.01)
G09G 3/3233 (2016.01)

(52) **U.S. Cl.**
CPC ***G09G 3/2007*** (2013.01); ***G09G 3/3233*** (2013.01); *G09G 2300/0819* (2013.01); *G09G 2300/0842* (2013.01); *G09G 2310/027* (2013.01); *G09G 2320/041* (2013.01); *G09G 2320/0673* (2013.01)

(58) **Field of Classification Search**
CPC G09G 3/2007; G09G 3/3233; G09G 2300/0819; G09G 2300/0842; G09G 2310/027; G09G 2320/041; G09G 2320/0673
See application file for complete search history.

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(57) **ABSTRACT**

A gamma voltage setting method of a display device includes: supplying, to a data driver, data corresponding to a specific grayscale of a specific dimming level; generating a data signal corresponding to the data in the data driver, using a gamma voltage corresponding to a processing gamma value; displaying an image corresponding to the data signal in a pixel unit; determining a temperature of the pixel unit; loading, from a look-up table, a target luminance and a target color coordinate, which correspond to the specific dimming level, the specific grayscale, and the temperature of the pixel unit; generating a gamma value such that an image corresponding to the target luminance and the target color coordinate is displayed in the pixel unit; and storing the gamma value.

13 Claims, 10 Drawing Sheets

DIMMING LEVEL(DEV)	GRAYSCALE(Gray)	TEMPERATURE(°C)	LUMINANCE(nit)	COLOR COORDINATE
1	10	0	45	x=0.304, y=0.316
		10	50	x=0.304, y=0.317
		...	...	...
		40	80	x=0.304, y=0.318
		50	100	x=0.305, y=0.320
		...	...	...
	60	0	200	x=0.304, y=0.324
		10	255	x=0.305, y=0.325
		...	...	...
		40	355	x=0.309, y=0.329
		50	400	x=0.310, y=0.330
		...	...	...
	...	...	...	...
	255	0	700	x=0.305, y=0.319
		10	800	x=0.305, y=0.320
		...	...	...
		40	1000	x=0.313, y=0.329
		50	1500	x=0.320, y=0.335
		...	...	...
...				
P	10	0	50	x=0.305, y=0.317
		10	70	x=0.305, y=0.318
		...	...	...
		40	100	x=0.305, y=0.319
		50	150	x=0.306, y=0.321
		...	...	...
	60	0	250	x=0.305, y=0.325
		10	300	x=0.306, y=0.326
		...	...	...
		40	400	x=0.310, y=0.330
		50	500	x=0.311, y=0.331
		...	...	...
	...	...	...	...
	255	0	800	x=0.306, y=0.320
		10	900	x=0.306, y=0.321
		...	...	...
		40	1200	x=0.314, y=0.330
		50	1800	x=0.321, y=0.336
		...	...	...

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FIG. 1

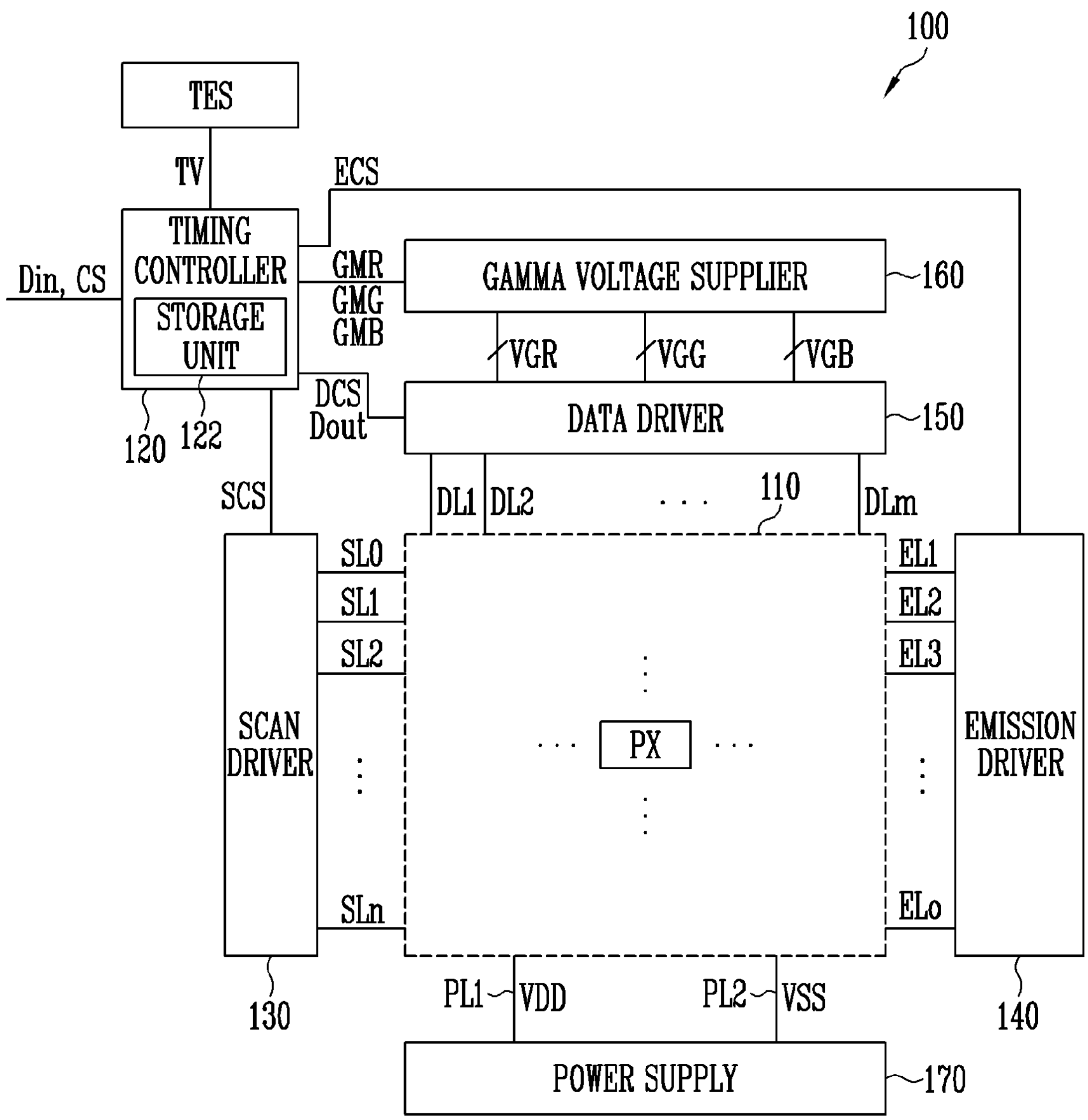

100
TES
TV
ECS
TIMING CONTROLLER
STORAGE UNIT
Din, CS
GMR
GMG
GMB
GAMMA VOLTAGE SUPPLIER
160
VGR
VGG
VGB
DCS
Dout
DATA DRIVER
150
120
122
SCS
DL1
DL2
110
DLm
SL0
SL1
SL2
SLn
EL1
EL2
EL3
ELo
SCAN DRIVER
PX
EMISSION DRIVER
130
140
PL1
VDD
PL2
VSS
POWER SUPPLY
170

FIG. 2A

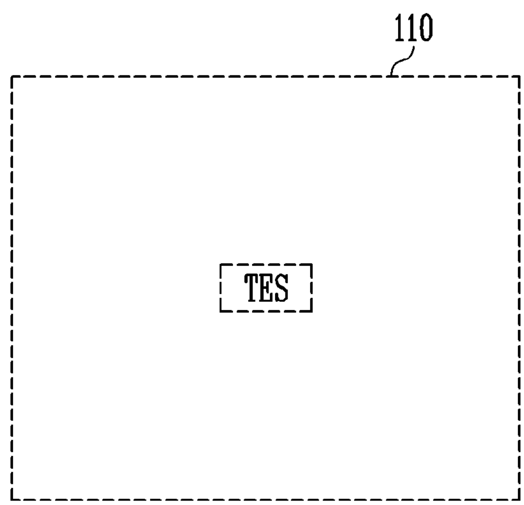


FIG. 2B

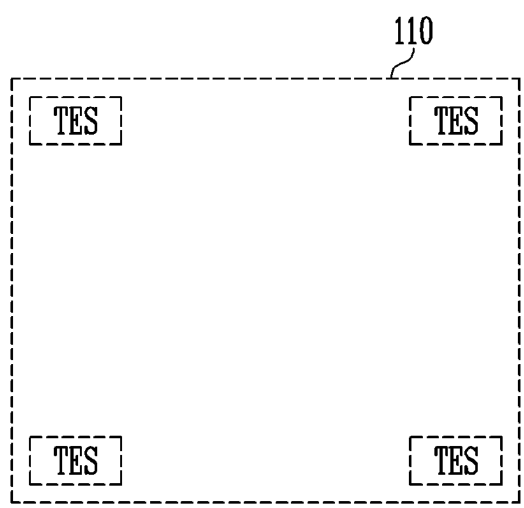
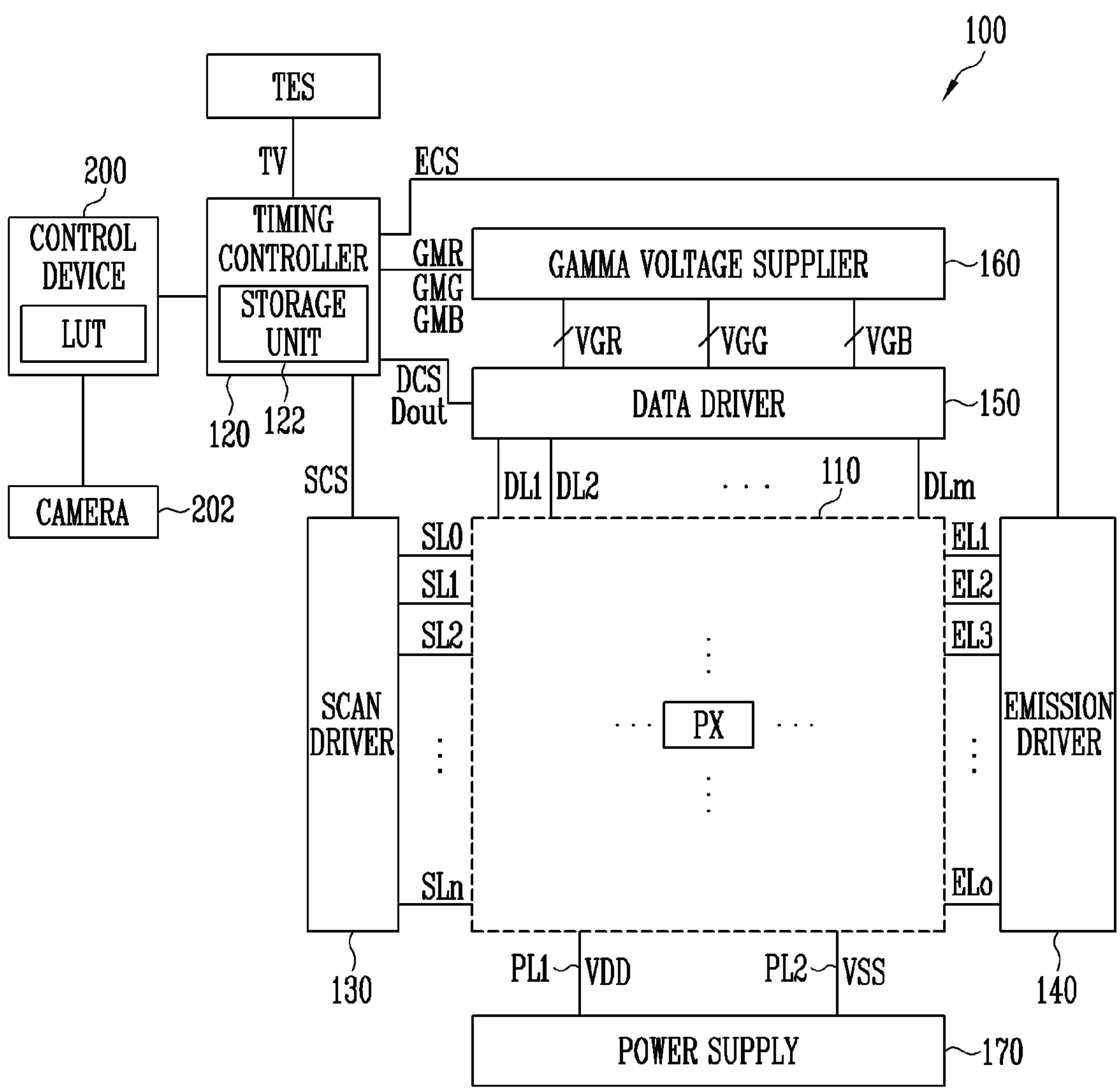


FIG. 3



100
TES
TV
ECS
200
CONTROL DEVICE
LUT
TIMING CONTROLLER
STORAGE UNIT
GMR
GMG
GMB
GAMMA VOLTAGE SUPPLIER
160
VGR
VGG
VGB
DCS
Dout
DATA DRIVER
150
120
122
CAMERA
202
SCS
DL1
DL2
110
DLm
SL0
SL1
SL2
EL1
EL2
EL3
SCAN DRIVER
PX
EMISSION DRIVER
SLn
ELo
PL1
VDD
PL2
VSS
130
140
POWER SUPPLY
170

FIG. 4

DIMMING LEVEL(DEV)	GRAYSCALE(Gray)	TEMPERATURE(°C)	LUMINANCE(nit)	COLOR COORDINATE
1	10	0	45	x=0.304, y=0.316
		10	50	x=0.304, y=0.317
		...	...	...
		40	80	x=0.304, y=0.318
		50	100	x=0.305, y=0.320
		...	...	...
	60	0	200	x=0.304, y=0.324
		10	255	x=0.305, y=0.325
		...	...	...
		40	355	x=0.309, y=0.329
		50	400	x=0.310, y=0.330
		...	...	...
	...	...	...	...
	255	0	700	x=0.305, y=0.319
		10	800	x=0.305, y=0.320
		...	...	...
		40	1000	x=0.313, y=0.329
		50	1500	x=0.320, y=0.335
		...	...	...
...				
p	10	0	50	x=0.305, y=0.317
		10	70	x=0.305, y=0.318
		...	...	...
		40	100	x=0.305, y=0.319
		50	150	x=0.306, y=0.321
		...	...	...
	60	0	250	x=0.305, y=0.325
		10	300	x=0.306, y=0.326
		...	...	...
		40	400	x=0.310, y=0.330
		50	500	x=0.311, y=0.331
		...	...	...
	...	...	...	...
	255	0	800	x=0.306, y=0.320
		10	900	x=0.306, y=0.321
		...	...	...
		40	1200	x=0.314, y=0.330
		50	1800	x=0.321, y=0.336
		...	...	...

FIG. 5

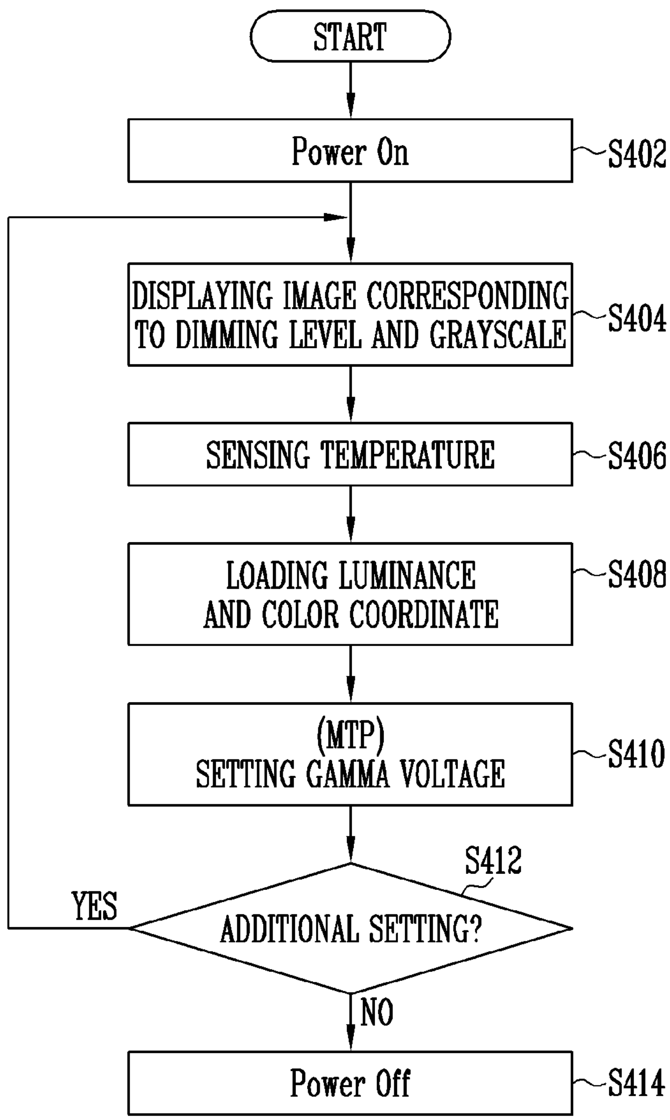

START
Power On
S402
DISPLAYING IMAGE CORRESPONDING TO DIMMING LEVEL AND GRAYSCALE
S404
SENSING TEMPERATURE
S406
LOADING LUMINANCE AND COLOR COORDINATE
S408
(MTP) SETTING GAMMA VOLTAGE
S410
S412
YES
ADDITIONAL SETTING?
NO
Power Off
S414

FIG. 6

DIMMING LEVEL(DEV)	GRAYSCALE(Gray)	TEMPERATURE(°C)	GMR	GMG	GMB
1	10	0	GMR11a	GMG11a	GMB11a
		10	GMR12a	GMG12a	GMB12a
		...	...	...	...
		40	GMR13a	GMG13a	GMB13a
		50	GMR14a	GMG14a	GMB14a
		...	...	...	...
	60	0	GMR21a	GMG21a	GMB21a
		10	GMR22a	GMG22a	GMB22a
		...	...	...	...
		40	GMR23a	GMG23a	GMB23a
		50	GMR24a	GMG24a	GMB24a
		...	...	...	...
	...	...	...	...	...
	255	0	GMR31a	GMG31a	GMB31a
		10	GMR32a	GMG32a	GMB32a
		...	...	...	...
		40	GMR33a	GMG33a	GMB33a
		50	GMR34a	GMG34a	GMB34a
		...	...	...	...
...					
p	10	0	GMR11b	GMG11b	GMB11b
		10	GMR12b	GMG12b	GMB12b
		...	...	...	...
		40	GMR13b	GMG13b	GMB13b
		50	GMR14b	GMG14b	GMB14b
		...	...	...	...
	60	0	GMR21b	GMG21b	GMB21b
		10	GMR22b	GMG22b	GMB22b
		...	...	...	...
		40	GMR23b	GMG23b	GMB23b
		50	GMR24b	GMG24b	GMB24b
		...	...	...	...
	...	...	...	...	...
	255	0	GMR31b	GMG31b	GMB31b
		10	GMR32b	GMG32b	GMB32b
		...	...	...	...
		40	GMR33b	GMG33b	GMB33b
		50	GMR34b	GMG34b	GMB34b
		...	...	...	...

FIG. 7

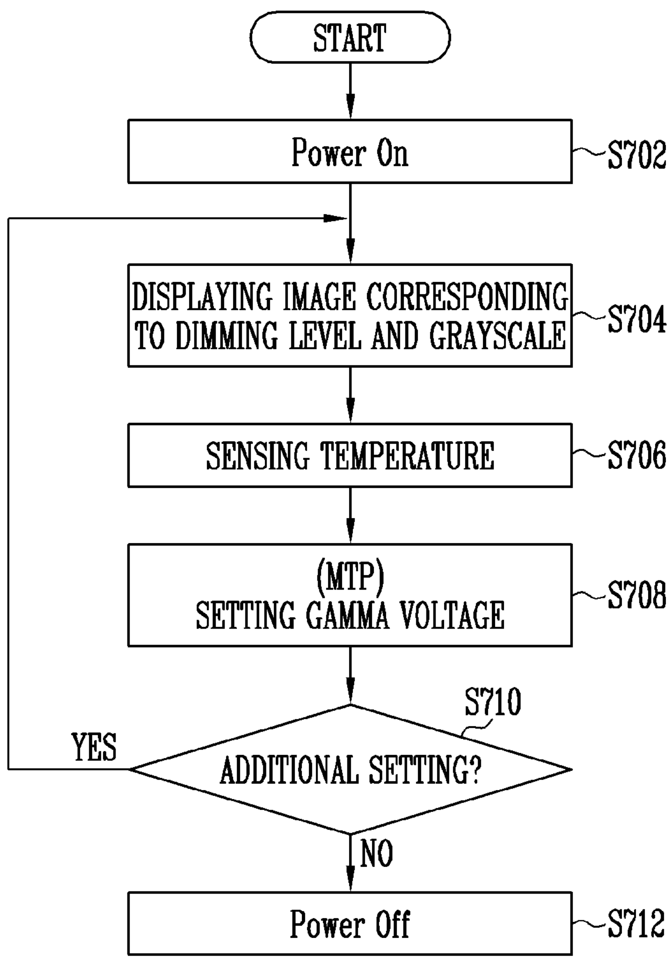

START
Power On
S702
DISPLAYING IMAGE CORRESPONDING TO DIMMING LEVEL AND GRAYSCALE
S704
SENSING TEMPERATURE
S706
(MTP)
SETTING GAMMA VOLTAGE
S708
S710
YES
ADDITIONAL SETTING?
NO
Power Off
S712

FIG. 8

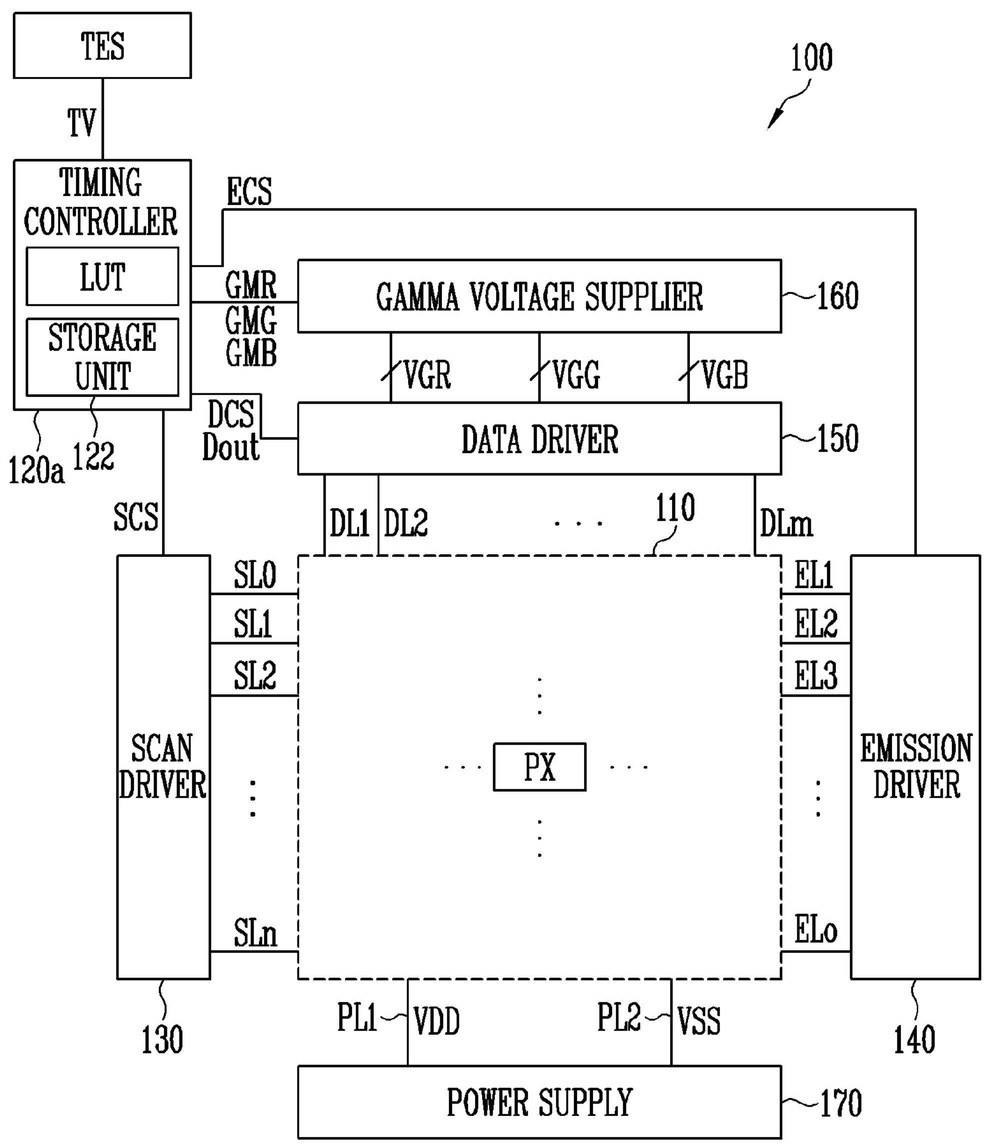

TES
TV
TIMING CONTROLLER
LUT
STORAGE UNIT
120a
122
ECS
GMR
GMG
GMB
DCS
Dout
SCS
100
GAMMA VOLTAGE SUPPLIER
160
VGR
VGG
VGB
DATA DRIVER
150
DL1
DL2
110
DLm
SL0
SL1
SL2
SLn
EL1
EL2
EL3
ELo
SCAN DRIVER
PX
EMISSION DRIVER
130
140
PL1
VDD
PL2
VSS
POWER SUPPLY
170

FIG. 9

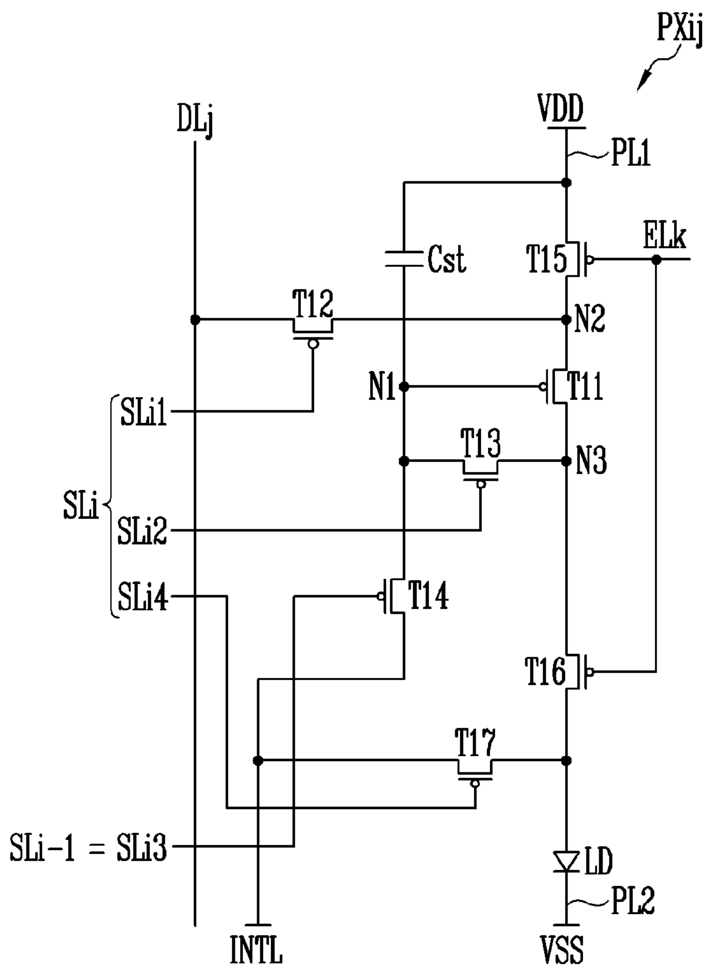
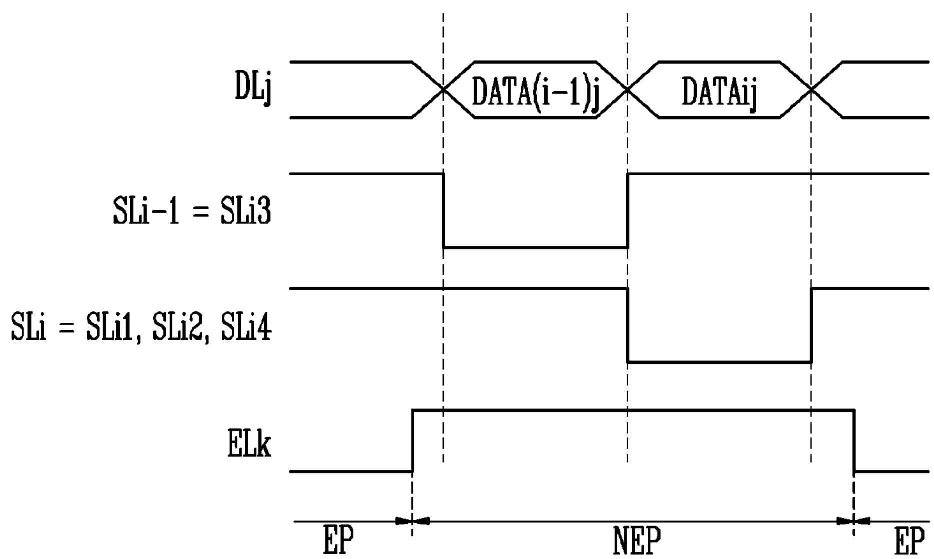

PXij
VDD
PL1
DLj
ELk
Cst
T15
T12
N2
N1
T11
SLi1
T13
N3
SLi
SLi2
SLi4
T14
T16
T17
SLi-1 = SLi3
LD
PL2
INTL
VSS

FIG. 10



DISPLAY DEVICE AND GAMMA VOLTAGE SETTING METHOD THEREOF

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims priority under 35 U.S.C. § 119 (a) to Korean patent application No. 10-2023-0135343, filed on Oct. 11, 2023, in the Korean Intellectual Property Office, the entire disclosure of which is incorporated herein by reference.

BACKGROUND

1. Technical Field

The present disclosure generally relates to a display device and a gamma voltage setting method thereof.

2. Related Art

With the development of information technologies, the importance of a display device which is a connection medium between a user and information increases. Accordingly, display devices such as a liquid crystal display device and an organic light emitting display device are increasingly used.

A display device may be supplied with data from a host, and convert the data into a data signal to be supplied to pixels, thereby displaying a predetermined image in a pixel unit. The display device may generate a data signal using a gamma voltage. Meanwhile, the luminance and color coordinate of the image displayed in the pixel unit may be changed according to a temperature of the display device, and accordingly, it is necessary for a temperature characteristic to be reflected when the gamma voltage is set for the first time (or during a manufacturing process).

SUMMARY

Embodiments provide a display device and a gamma voltage setting method thereof, in which a gamma voltage can be set in consideration of a temperature characteristic.

In accordance with an aspect of the present disclosure, there is provided a gamma voltage setting method of a display device, including: supplying data corresponding to a specific grayscale of a specific dimming level to a data driver; generating a data signal corresponding to the data in the data driver using a gamma voltage corresponding to a processing gamma value; displaying an image corresponding to the data signal in a pixel unit; determining a temperature of the pixel unit; loading, from a look-up table, a target luminance and a target color coordinate, which correspond to the specific dimming level, the specific grayscale, and the temperature of the pixel unit; generating a gamma value such that an image corresponding to the target luminance and the target color coordinate is displayed in the pixel unit; and storing the gamma value.

The gamma value may be stored in the display device during a manufacturing process of the display device.

The gamma value may include a first gamma value corresponding to a pixel of a first color, a second gamma value corresponding to a pixel of a second color, and a third gamma value corresponding to a pixel of a third color.

A plurality of dimming levels, a plurality of grayscales included in each of the plurality of dimming levels, and the target luminance and the target color coordinate, which correspond to at least two different temperatures in each of the plurality of grayscales, may be stored in the look-up table.

The gamma voltage setting method may further include sensing whether the image corresponding to the target luminance and the target color coordinate is displayed in the pixel unit using a camera.

In accordance with another aspect of the present disclosure, there is provided a gamma voltage setting method of a display device, including: supplying, to a data driver, data corresponding to a specific grayscale of a specific dimming level; generating a data signal corresponding to the data in the data driver using a gamma voltage corresponding to a processing gamma value; displaying an image in a pixel unit corresponding to the data signal; determining a temperature of the pixel unit; loading, from a look-up table, a gamma value corresponding to the specific dimming level, the specific grayscale, and the temperature of the pixel unit; and storing the gamma value.

The gamma value may be stored in the display device during a manufacturing process of the display device.

The gamma value may include a first gamma value corresponding to a pixel of a first color, a second gamma value corresponding to a pixel of a second color, and a third gamma value corresponding to a pixel of a third color.

A plurality of dimming levels, a plurality of grayscales included in each of the plurality of dimming levels, and the gamma value corresponding to at least two different temperatures in each of the plurality of grayscales may be stored in the look-up table.

In accordance with still another aspect of the present disclosure, there is provided a display device including: a pixel unit including pixels connected to scan lines and data lines; a data driver configured to supply a data signal to the data lines; a gamma voltage supplier configured to supply a gamma voltage to the data driver corresponding to a gamma value; a timing controller including a storage unit configured to store the gamma value and a look-up table; and a temperature sensor configured to sense a temperature of the pixel unit, wherein a plurality of dimming levels, a plurality of grayscales included in each of the plurality of dimming levels, and gamma value setting information corresponding to at least two different temperatures in each of the plurality of grayscales are stored in the look-up table, and wherein the gamma value setting information corresponds to a target luminance and a target color coordinate of the pixel unit which correspond to the different temperatures, or the gamma value corresponding to the different temperatures.

The gamma value may include a first gamma value corresponding to a pixel of a first color, a second gamma value corresponding to a pixel of a second color, and a third gamma value corresponding to a pixel of a third color.

The timing controller may display an image corresponding to a specific grayscale of a specific dimming level in the pixel unit during a manufacturing process, and store, in the storage unit, the gamma value corresponding to the specific grayscale of the specific dimming level and a target luminance and a target color coordinate, which correspond to a temperature of the pixel unit, which is measured from the temperature sensor.

The timing controller may display an image corresponding to a specific grayscale of a specific dimming level in the pixel unit during a manufacturing process, load, from the look-up table, the gamma value corresponding to the specific grayscale of the specific dimming level and a temperature of the pixel unit, which is measured from the temperature sensor, and store the gamma value in the storage unit.

BRIEF DESCRIPTION OF THE DRAWINGS

Example embodiments will now be described more fully hereinafter with reference to the accompanying drawings; however, they may be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the example embodiments to those skilled in the art.

In the drawing figures, dimensions may be exaggerated for clarity of illustration. It will be understood that when an element is referred to as being "between" two elements, it can be the only element between the two elements, or one or more intervening elements may also be present. Like reference numerals refer to like elements throughout.

FIG. **1** is a diagram illustrating a display device in accordance with an embodiment of the present disclosure.

FIGS. **2**A and **2**B are diagrams illustrating positions of a temperature sensor in accordance with an embodiment of the present disclosure.

FIG. **3** is a diagram illustrating a state in which a control device for setting a gamma value during a manufacturing process is attached to the display device.

FIG. **4** is a diagram illustrating an embodiment of a look-up table LUT included in the control device shown in FIG. **3**.

FIG. **5** is a flowchart illustrating an embodiment of a process of setting a gamma value (or gamma voltage).

FIG. **6** is a diagram illustrating an embodiment of the look-up table included in the control device shown in FIG. **3**.

FIG. **7** is a flowchart illustrating an embodiment of a process of setting a gamma value using the look-up table shown in FIG. **6**.

FIG. **8** is a diagram illustrating a display device in accordance with an embodiment of the present disclosure.

FIG. **9** is a diagram illustrating an embodiment of a pixel shown in FIG. **1**.

FIG. **10** is a diagram illustrating an exemplary driving method of the pixel shown in FIG. **9**.

DETAILED DESCRIPTION

Hereinafter, exemplary embodiments are described in detail with reference to the accompanying drawings so that those skilled in the art may easily practice the present disclosure. The present disclosure may be implemented in various different forms and is not limited to the exemplary embodiments described in the present specification.

A part irrelevant to the description will be omitted to clearly describe the present disclosure, and the same or similar constituent elements will be designated by the same reference numerals throughout the specification. Therefore, the same reference numerals may be used in different drawings to identify the same or similar elements.

In description, the expression "equal" may mean "substantially equal." That is, this may mean equality to a degree to which those skilled in the art can understand the equality. Other expressions may be expressions in which "substantially" is omitted.

Some embodiments are described in the accompanying drawings in relation to functional blocks, units, and/or modules. Those skilled in the art will understand that these blocks, units, and/or modules are physically implemented by logic circuits, individual components, microprocessors, hard wire circuits, memory elements, line connection, and other electronic circuits. This may be formed by using semiconductor-based manufacturing techniques or other manufacturing techniques. In the case of blocks, units, and/or modules implemented by microprocessors or other similar hardware, the units, and/or modules are programmed and controlled by using software, to perform various functions discussed in the present disclosure, and may be selectively driven by firmware and/or software. In addition, each block, each unit, and/or each module may be implemented by dedicated hardware or by a combination dedicated hardware to perform some functions of the block, the unit, and/or the module and a processor (e.g., one or more programmed microprocessors and associated circuitry) to perform other functions of the block, the unit, and/or the module. In some embodiments, the blocks, the units, and/or the modules may be physically separated into two or more individual blocks, two or more individual units, and/or two or more individual modules without departing from the scope of the present disclosure. Also, in some embodiments, the blocks, the units, and/or the modules may be physically separated into more complex blocks, more complex units, and/or more complex modules without departing from the scope of the present disclosure.

The term "connection" between two components may include both electrical connection and physical connection, but the present disclosure is not necessarily limited thereto. For example, the term "connection" used based on circuit diagrams may mean electrical connection, and the term "connection" used based on sectional and plan views may mean physical connection.

It will be understood that, although the terms "first," "second," etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another element. Thus, a "first" element discussed below could also be termed a "second" element without departing from the teachings of the present disclosure.

Meanwhile, the present disclosure is not limited to embodiments disclosed below, and may be implemented in various forms. Each embodiment disclosed below may be independently embodied or be combined with at least another embodiment prior to being embodied.

FIG. **1** is a diagram illustrating a display device in accordance with an embodiment of the present disclosure.

Referring to FIG. **1**, the display device **100** in accordance with the embodiment of the present disclosure may include a pixel unit **110** (or display panel), a timing controller **120**, a scan driver **130**, an emission driver **140**, a data driver **150**, a gamma voltage supplier **160**, a power supply **170**, and a temperature sensor TES. The timing controller **120**, the scan driver **130**, the emission driver **140**, the data driver **150**, the gamma voltage supplier **160**, the power supply **170**, and the temperature sensor TES may constitute a driving device which drives the pixel unit **110**.

The pixel unit **110** may display images. The pixel unit **110** may be any one of an organic light emitting display panel, a liquid crystal display panel, an electrophoretic display panel, and an inorganic light emitting display panel. The pixel unit **110** may include pixels PX connected to scan lines SL**0**, SL**1**, SL**2**, . . . , and SLn, data lines DL**1**, DL**2**, . . . , and DLm, emission control lines EL**1**, EL**2**, EL**3**, . . . , and ELo), and power lines PL**1** and PL**2** (n, m, and o are natural numbers of 2 or more).

The pixels PX may be disposed in areas defined by the scan lines SL**0** to SLn, the data line DL**1** to DLm, and the emission control lines EL**1** to ELo. Each of the pixels PX may be connected to any one of the scan lines SL**0** to SLn, any one of the data lines DL1 to DLm, and any one of the emission control lines EL1 to ELo. For example, a pixel PXij (see FIG. 9) located on an ith row and a jth column may be connected to an (i−1) th scan line SLi−1, an ith scan line SLi, a jth data line DLj, and a kth emission control line ELk.

Here, k may be a number equal to or smaller than i. In an example, when each of the emission control lines EL1 to ELo is connected to pixels PX located on one horizontal line, k may be a number equal to i. In an example, when each of the emission control lines EL1 to ELo is connected to pixels PX located on two or more horizontal lines, k may be a number smaller than i.

Each of the pixels PX may be electrically connected between a first power line PL1 and a second power line PL2. A voltage of a first power source VDD may be applied to the first power line PL1, and a voltage of a second power source VSS may be applied to the second power line PL2. The first power source VDD and the second power source VSS may be power voltages or driving voltages, necessary for operations of the pixels PX, and the first power source VDD may have a voltage level higher than a voltage level of the second power source VSS during the pixels PX emit light.

Each of the pixels PX may be supplied with a data signal from a data line connected thereto when a scan signal (or enable scan signal) is supplied to a scan line connected thereto. The pixel supplied with the data signal may emit light with a luminance corresponding to the data signal to the outside. To this end, the pixels PX may include pixels of a first color, pixels of a second color, and pixels of a third color. The first color, the second color, and the third color may be different colors. In an example, the first color may be red, the second color may be green, and the third color may be blue. In another example, the first color may be magenta, the second color may be cyan, and the third color may be yellow.

Additionally, signal lines (e.g., a scan line, a data line, and an emission control line) connected to each of the pixels PX and a driving method of the pixel may be changed corresponding to a structure of the pixel. In an example, the emission control line may be removed corresponding to the structure of the pixel. In an embodiment of the present disclosure, the pixel may be selected as any one of various pixels currently known in the art.

The scan driver **130** may generate scan signals in response to a scan driving signal SCS from the timing controller **120** and sequentially supply the scan signals to the scan lines SL0 to SLn. In an example, the timing controller **120** may supply the scan driving signal SCS including a scan start signal, a clock signal, and the like to the scan driver **130**. The scan driver **130** may be implemented as a shift register which sequentially generates and outputs the scan signal while shifting the scan start signal according to the clock signal.

The emission driver **140** may generate emission control signals in response to an emission driving signal ECS from the timing controller **120** and sequentially supply the emission control signals to the emission control lines EL1 to ELo. In an example, the timing controller **120** may supply the emission driving signal ECS including an emission start signal, a clock signal, and the like to the emission driver **140**. The emission driver **140** may be implemented as a shift register which sequentially generates and outputs the emission control signal while shifting the emission start signal according to the clock signal.

The scan driver **130** and the emission driver **140** may be formed together with the pixels PX in the pixel unit **110**. However, the present disclosure is not limited thereto. For example, the scan driver **130** and/or the emission driver **140** may be mounted on a circuit film, and be connected to the timing controller **120** via at least one circuit film and at least one printed circuit board.

The data driver **150** may be supplied with a data driving signal DCS and output data Dout from the timing controller **120**. The data driving signal DCS may include a sampling signal and/or timing signals, necessary for driving of the data driver **150**. Also, the data driver **150** may be supplied with gamma voltages VGR, VGG, and VGB from the gamma voltage supplier **160**.

The data driver **150** may select any one of the gamma voltages VGR, VGG, and VGB which corresponds to a grayscale of the output data Dout, thereby generating a data signal. The data driver **150** may supply the data signal to the pixel unit **110** one pixel row (or horizontal line) at a time. The one pixel row may mean a row in which pixels connected to the same scan line are disposed.

The gamma voltage supplier **160** may be supplied with gamma values GMR, GMG, and GMB from the timing controller **120**. The gamma values GMR, GMG, and GMB may include a first gamma value GMR, a second gamma value GMG, and a third gamma value GMB.

The first gamma value GMR may include a plurality of data (or signals), and have a gamma value corresponding to the pixels of the first color. The second gamma value GMG may include a plurality of data (or signals), and have a gamma value corresponding to the pixels of the second color. The third gamma value GMB may include a plurality of data, and have a gamma value corresponding to the pixels of the third color.

The gamma voltage supplier **160** may supply a first gamma voltage VGR to the data driver **150** corresponding to the first gamma value GMR. The first gamma voltage VGR may include gamma voltages corresponding to each of grayscales (e.g., 256 grayscales), and the data driver **150** may generate a data signal to be supplied to the pixels of the first color using the first gamma voltage VGR.

The gamma voltage supplier **160** may supply a second gamma voltage VGG to the data driver **150** corresponding to the second gamma value GMG. The second gamma voltage VGG may include gamma voltages corresponding to each of grayscales (e.g., 256 grayscales), and the data driver **150** may generate a data signal to be supplied to the pixels of the second color using the second gamma voltage VGG.

The gamma voltage supplier **160** may supply a third gamma voltage VGB to the data driver **150** corresponding to the third gamma value GMB. The third gamma voltage VGB may include gamma voltages corresponding to each of grayscales (e.g., 256 grayscales), and the data driver **150** may generate a data signal to be supplied to the pixels of the third color using the third gamma voltage VGB.

In FIG. 1, it is illustrated that the gamma voltage supplier **160** and the data driver **150** are components separate from each other. However, the embodiment of the present disclosure is not limited thereto. In an example, the gamma voltage supplier **160** and the data driver **150** may be embedded into one integrated circuit.

The timing controller **120** may receive input data Din and a control signal CS from a host system through an interface. In an example, the timing controller **120** may receive the input data Din and the control signal CS from at least one of a Graphics Processing Unit (GPU), a Central Processing Unit (CPU), and an Application Processor (AP), which are included in the host system. Various signals including a clock signal may be included in the control signal CS.

The timing controller **120** may generate the scan driving signal SCS, the data driving signal DCS, and the emission driving signal ECS based on the control signal CS. The scan driving signal SCS, the data driving signal DCS, and the emission driving signal ECS may be supplied to the scan driver **130**, the data driver **150**, and the emission driver **140**, respectively.

The timing controller **120** may rearrange the input data Din to be suitable for specifications of the display device **100**. Also, the timing controller **120** may generate output data Dout by correcting the input data Din, and supply the output data Dout to the data driver **150**. In an embodiment, the timing controller **120** may correct the input data Din corresponding to an optical measurement result measured during a manufacturing process.

A storage unit **122** may be provided inside the timing controller **120**. Gamma values GMR, GMG, and GMB corresponding to gamma voltages may be stored in the storage unit **122**. In an example, the gamma values GMR, GMG, and GMB may be stored during the manufacturing process. A value of each of the gamma values GMR, GMG, and GMB may be set in consideration of a temperature of the display device **100**, and accordingly, an image can be stably displayed regardless of temperature.

The power supply **170** may generate various power sources necessary for driving the display device **100**. In an example, the power supply **170** may generate the first power source VDD and the second power source VSS. The power supply **170** may further generate various power sources (e.g., an initialization power source), corresponding to the structure of the pixels PX. The first power source VDD may be a power source which supplies a driving current to the pixels PX. The second power source VSS may be a power source which is supplied with the driving current from the pixels PX. The first power source VDD may be set to a voltage higher than a voltage of the second power source VSS during a period in which the pixels PX are set to be in an emission state.

The voltage of the first power source VDD generated by the power supply **170** may be supplied to the first power line PL**1**, and the voltage of the second power source VSS generated by the power supply **170** may be supplied to the second power line PL**2**. The first power line PL**1** and the second power line PL**2** may be commonly connected to the pixels PX, but the embodiment of the present disclosure is not limited thereto. In an embodiment, the first power line PL**1** may include a plurality of power lines, and the plurality of power lines may be connected to different pixels PX. In an embodiment, the second power line PL**2** may include a plurality of power lines, and the plurality of power lines may be connected to different pixels PX.

The temperature sensor TES may sense a temperature of the pixel unit **110**, and supply a temperature value TV corresponding to the sensed temperature to the timing controller **120**. The timing controller **120** may change the gamma values GMR, GMG, and GMB corresponding to the temperature value TV.

FIGS. **2**A and **2**B are diagrams illustrating positions of the temperature sensor in accordance with an embodiment of the present disclosure.

Referring to FIG. **2**A, the temperature sensor TES may be disposed to overlap with the pixel unit **110**. In an example, the temperature sensor TES may be located at a central portion of the pixel unit **110**, and supply a temperature value TV corresponding to a temperature of the central portion of the pixel unit **110** to the timing controller **120**. The timing controller **120** may calculate a temperature of the entire pixel unit **110** based on the temperature value TV.

Referring to FIG. **2**B, at least two temperature sensors TES may be disposed at outer portions of the pixel unit **110**. In an example, the temperature sensor TES may be respectively disposed at the outer portions of the pixel unit **110**, and supply temperature values TV corresponding to temperatures of the outer portions of the pixel unit **110** to the timing controller **120**. The timing controller **120** may calculate (e.g., average) a temperature of the entire pixel unit **110** based on the temperature values TV.

FIG. **3** is a diagram illustrating a state in which a control device for setting a gamma value during the manufacturing process is attached to the display device. FIG. **4** is a diagram illustrating an embodiment of a look-up table LUT included in the control device shown in FIG. **3**. FIG. **5** is a flowchart illustrating an embodiment of a process of setting a gamma value (or gamma voltage). The gamma value may be set for each display device **100** through Multi-Time Programming (MTP).

Referring to FIG. **3**, a control device **200** for setting a gamma value may be electrically connected to the timing controller **120** such that a gamma value (or gamma voltage) is set during the manufacturing process.

The control device **200** may be connected to a camera **202**. The camera **202** may sense an image displayed in the pixel unit **110** and supply the image to the control device **200**. The control device **200** may determine a luminance and a color coordinate of the pixel unit **110** by using the image supplied from the camera **202**.

The control device **200** may include a look-up table LUT, and information for setting a gamma value may be stored in the look-up table LUT. In an example, the look-up table LUT may include a plurality of dimming levels DEV**1**, . . . , and DEVp (p is a natural number of 2 or more) as shown in FIG. **4**, and each of the dimming levels DEV**1**, . . . , and DEVp may include a plurality of grayscales (e.g., 10 Gray, 60 Gray, . . . , and 255 Gray). In addition, luminance and color coordinate information to be displayed in the pixel unit **110** when each of the plurality of grayscales is driven at at least two different temperatures (e.g., 0° C., 10° C., . . . , 40° C., 50° C., . . .) may be stored in the look-up table LUT.

The look-up table LUT may include a maximum luminance which can be emitted from the pixel unit **110** according to the dimming levels DEV**1**, . . . , and DEVp. For example, as the dimming levels DEV**1**, . . . , and DEVp increase, the maximum luminance which can be emitted from the pixel unit **110** may increase too. The maximum luminance may be a luminance measured when the entire pixel unit **110** emits light with a maximum grayscale which is set in the display device **100**.

The plurality of grayscales included in each of the dimming levels DEV**1**, . . . , and DEVp may mean grayscales displayed in the pixel unit **110** when a gamma value is set.

The plurality of grayscales may be pre-stored in the look-up table LUT such that the gamma value is stably set. The plurality of grayscales shown in FIG. **4** are merely illustrative, and the grayscales included in each of the dimming levels DEV**1**, . . . , and DEVp may be variously set.

A plurality of temperatures included in each of the grayscales may mean temperatures of the pixel unit **110** (or temperatures of the display device **100**). In addition, luminance and color coordinate information (or gamma value setting information) corresponding to each of the plurality of temperatures may mean target luminance and target color coordinate information of an image displayed in the pixel unit **110** when the display device **100** is driven at a specific dimming level, a specific grayscale, and a specific temperature. The plurality of temperatures shown in FIG. **4** are merely illustrative, and the temperatures stored in the look-up table LUT may be variously set.

When temperature information is included in the look-up table LUT, a gamma value (or gamma voltage) may be set in consideration of the temperature information (or a temperature characteristic) during the manufacturing process. As such, when the temperature characteristic is reflected on the gamma value, the display quality of the display device **100** can be improved and a processing time can be shortened.

More specifically, when the temperature information is not included in the look-up table LUT, the gamma value may be set at a room temperature. Since a temperature of a processing line is to be set to the room temperature, a predetermined time may be required. In addition, the temperature of the pixel unit **110** may be changed in a gamma value setting process, and a desired luminance (and a desired color coordinate) may not be displayed in the display device **100** since the temperature characteristic is not reflected on the gamma value.

Referring to FIG. **5**, power may be supplied to the display device **100** to set up a gamma value during the manufacturing process (S**402**). After the power is input to the display device **100**, the control device **200** may supply processing data (or data) and a processing gamma value corresponding to a dimming level DEV and a grayscale Gray to the timing controller **120**. The processing gamma value may be an initial gamma value that dose not reflect the characteristic of the display device **100**.

The processing data may be supplied to the data driver **150** via the timing controller **120**, and the processing gamma value may be supplied to the gamma voltage supplier **160** via the timing controller **120**. The gamma voltage supplier **160** supplied with the processing gamma value may supply gamma voltages VGR, VGG, and VGB corresponding to the processing gamma value to the data driver **150**.

The data driver **150** supplied with the processing data may generate a data signal using the gamma voltages VGR, VGG, and VGB, and supply the data signal to the pixel unit **110**. An image corresponding to a specific dimming level and a specific grayscale may be displayed in the pixel unit **110** (S**404**).

When a predetermined image is displayed in the pixel unit **110**, the temperature sensor TES may sense a temperature of the pixel unit **110**, and supply a temperature value TV corresponding to the sensed temperature to the timing controller **120** (S**406**). The timing controller **120** may supply the temperature value TV to the control device **200**. Then, the control device **200** may load a luminance and a color coordinate from the look-up table LUT which correspond to the temperature (S**408**).

In an example, when processing data corresponding to a first dimming level DEV**1** and 255 Gray are supplied, and the temperature value TV corresponds to 40° C., the control device **200** may load a luminance of 1000 nit and a color coordinate of x=0.313 and y=0.329 in the step S**408**. In an example, when the processing data corresponding to the first dimming level DEV**1** and the 255 Gray are supplied, and the temperature value TV corresponds to 50° C., the control device **200** may load a luminance of 1500 nit and a color coordinate of x=0.320 and y=0.335 in the step S**408**.

The predetermined image displayed in the pixel unit **110** may be captured by the camera **202** and supplied to the control device **200**. The control device **200** may determine a luminance and a color coordinate of the predetermined image displayed in the pixel unit **110** by using the captured image supplied from the camera **202**. After that, the control device **200** may change the processing gamma value such that an image of the luminance and the color coordinate, which are loaded in the step S**408** in the pixel unit **110**, can be displayed in the pixel unit **110** (S**410**). Also, the control device **200** may store the processing gamma value in the storage unit **122** when the image of the luminance and the color coordinate, which are loaded in the step S**408** in the pixel unit **110**, is displayed in the pixel unit **110** as gamma values GMR, GMG, and GMB. The gamma values GMR, GMG, and GMB on which a temperature characteristic is reflected may be stored in the storage unit **122**.

After gamma values GMR, GMG, and GMB corresponding to a specific dimming level and a specific grayscale are stored in the step S**410**, the control device **200** may determine whether additional gamma value setting is required (S**412**). In an embodiment, the control device **200** may store gamma values GMR, GMG, and GMB corresponding to all grayscale values included in each of a plurality of dimming levels in the storage unit **122** while repeating the steps S**404** to S**410**.

When the additional gamma value setting is not required in the step S**412**, the power supply of the display device **100** may be suspended (S**414**). In an embodiment of the present disclosure, the gamma values GMR, GMG, and GMB may be stored in the storage unit **122** during the manufacturing process while going through the steps S**402** to S**414**.

FIG. **6** is a diagram illustrating an embodiment of the look-up table included in the control device shown in FIG. **3**.

Referring to FIG. **6**, the control device **200** may include a look-up table LUT, and information for setting a gamma value may be stored in the look-up table LUT. In an example, grayscales (e.g., 10 Gray, 60 Gray, . . . , and 255 Gray) displayed at each of dimming levels DEV**1**, . . . , and DEVp may be included in the look-up table LUT. In addition, gamma values GMR, GMG, and GMB corresponding to temperatures (e.g., 0° C., 10° C., . . . , 40° C., 50° C., . . .) of each of the grayscales may be stored in the look-up table LUT.

In an example, a plurality of dimming levels DEV**1**, . . . , and DEVp may be included in the look-up table LUT, and each of the plurality of dimming levels DEV**1**, . . . , and DEVp may include a plurality of grayscales (e.g., 10 Gray, 60 Gray, . . . , and 255Gray). Grayscale information shown in FIG. **6** is merely illustrative, and the grayscales in each of the dimming levels DEV**1**, . . . , and DEVp may be variously set.

Each of the grayscales may include a plurality of temperature information (e.g., 0° C., 10° C., . . . , 40° C., 50° C., . . .). The temperature information may correspond to a temperature of the pixel unit **110**, and gamma values GMR, GMG, and GMB (or gamma value setting information) corresponding to each temperature may be stored in the look-up table LUT.

In an embodiment, first gamma values GMR (GMR**11***a*, GMR**12***a*, . . . , GMR**13***a*, GMR**14***a*, . . . , GMR**21***a*, GMR**22***a*, . . . , GMR**23***a*, GMR**24***a*, . . . , GMR**31***a*, GMR**32***a*, . . . , GMR**33***a*, and GMR**34***a*) respectively corresponding to temperatures of grayscales at a first dimming level DEV**1** may be stored in the look-up table LUT. In an embodiment, first gamma values GMR (GMR**11***b*, GMR**12***b*, . . . , GMR**13***b*, GMR**14***b*, ... GMR**21***b*, GMR**22***b*, . . . , GMR**23***b*, GMR**24***b*, . . . , GMR**31***b*, GMR**32***b*, . . . , GMR**33***b*, and GMR**34***b*) respectively corresponding to temperatures of grayscales at a pth dimming level DEVp may be stored in the look-up table LUT. The first gamma values GMR may be experimentally predetermined.

In an embodiment, second gamma values GMG (GMG**11***a*, GMG**12***a*, . . . GMG**13***a*, GMG**14***a*, GMG**21***a*, GMG**22***a*, . . . , GMG**23***a*, GMG**24***a*, . . . , GMG**31***a*, GMG**32***a*, . . . , GMG**33***a*, and GMG**34***a*) respectively corresponding to the temperatures of the grayscales at the first dimming level DEV**1** may be stored in the look-up table LUT. In addition, second gamma values GMG (GMG**11***b*, GMG**12***b*, . . . , GMG**13***b*, GMG**14***b*, . . . , GMG**21***b*, GMG**22***b*, . . . , GMG**23***b*, GMG**24***b*, . . . , GMG**31***b*, GMG**32***b*, . . . , GMG**33***b*, and GMB**34***b*) respectively corresponding to the temperatures of the grayscales at the pth dimming level DEVp may be stored in the look-up table LUT. The second gamma values GMG may be experimentally predetermined.

In an example, third gamma values GMB (GMB**11***a*, GMB**12***a*, . . . , GMB**13***a*, GMB**14***a*, . . . , GMB**21***a*, GMB**22***a*, . . . , GMB**23***a*, GMB**24***a*, ... GMB**31***a*, GMB**32***a*, . . . , GMB**33***a*, and GMB**34***a*) respectively corresponding to the temperatures of the grayscales at the first dimming level DEV**1** may be stored in the look-up table LUT. In addition, third gamma values GMB (GMB**11***b*, GMB**12***b*, . . . , GMB**13***b*, GMB**14***b*, . . . , GMB**21***b*, GMB**22***b*, . . . , GMB**23***b*, GMB**24***b*, . . . , GMB**31***b*, GMB**32***b*, . . . , GMB**33***b*, and GMB**34***b*) respectively corresponding to the temperatures of the grayscales at the pth dimming level DEVp may be stored in the look-up table LUT. The third gamma values GMB may be experimentally predetermined.

FIG. **7** is a flowchart illustrating an embodiment of a process of setting a gamma value using the look-up table shown in FIG. **6**.

Referring to FIGS. **6** and **7**, power may be supplied to the display device **100** to set up a gamma value during the manufacturing process (S**702**). After the power is input to the display device **100**, the control device **200** may supply processing data and a processing gamma value corresponding to a dimming level DEV and a grayscale Gray to the timing controller **120**. The processing data may be supplied to the data driver **150** via the timing controller **120** and the processing gamma value may be supplied to the gamma voltage supplier **160** via the timing controller **120**. The gamma voltage supplier **160** supplied with the processing gamma value may supply gamma voltages VGR, VGG, and VGB corresponding to the processing gamma value to the data driver **150**.

The data driver **150** supplied with the processing data may generate a data signal using the gamma voltages VGR, VGG, and VGB, and supply the data signal to the pixel unit **110**. An image corresponding to a specific dimming level and a specific grayscale may be displayed in the pixel unit **110** (S**704**).

When a predetermined image is displayed in the pixel unit **110**, the temperature sensor TES may sense a temperature of the pixel unit **110**, and supply a temperature value TV corresponding to the sensed temperature to the timing controller **120** (S**706**). The timing controller **120** may supply the temperature value TV to the control device **200**.

The control device **200** supplied with the temperature value TV may load gamma values GMR, GMG, and GMB corresponding to the dimming level DEV, the grayscale Gray, and the temperature value TV, and store the corresponding gamma values in the storage unit **122**.

In an example, when the processing data corresponding to the first dimming level DEV**1** and the 255 Gray are supplied, and the temperature value TV corresponds to 40° C., in in step S**708**, the control device **200** may store a first gamma value GMR**33***a*, a second gamma value GMG**33***a*, and a third gamma value GMB**33***a* in the storage unit **122**. In an example, when the processing data corresponding to the first dimming level DEV**1** and the 255 Gray are supplied, and the temperature value TV corresponds to 50° C., in the step S**708**, the control device **200** may store a first gamma value GMR**34***a*, a second gamma value GMG**34***a*, and a third gamma value GMB**34***a* in the storage unit **122**.

After gamma values GMR, GMG, and GMB corresponding to a specific dimming level and a specific grayscale are stored in step S**708**, the control device **200** may determine whether additional gamma value setting is required (S**710**). The control device **200** may store gamma values GMR, GMG, and GMB corresponding to all grayscale values included in each of a plurality of dimming levels, in the storage unit **122** while repeating the steps S**704** to S**708**.

When the additional gamma value setting is not required in the step S**7410**, the power supply of the display device **100** may be suspended (S**712**). The display device **100** in accordance with the embodiment of the present disclosure may store the gamma values GMR, GMG, and GMB in the storage unit **122** during the manufacturing process while going through the steps S**702** to S**712**.

When the look-up table shown in FIG. **6** is stored in the control device **200**, the control device **200** may store gamma values GMR, GMG, and GMB corresponding to a specific dimming level, a specific grayscale, and a specific temperature in the storage unit **122** without capturing any image displayed in the pixel unit **110**. Accordingly, the camera **202** shown in FIG. **3** may be omitted.

FIG. **8** is a diagram illustrating a display device in accordance with an embodiment of the present disclosure. In FIG. **8**, descriptions of portions overlapping with those shown in FIG. **3** will be omitted.

Referring to FIG. **8**, the display device **100** in accordance with the embodiment of the present disclosure may include a pixel unit **110** (or display panel), a timing controller **120***a*, a scan driver **130**, an emission driver **140**, a data driver **150**, a gamma voltage supplier **160**, a power supply **170**, and a temperature sensor TES.

The timing controller **120***a* may include a storage unit **122** and a look-up table LUT. Information for setting a gamma value may be stored in the look-up table LUT.

In an example, luminance and color coordinate information to be displayed in the pixel unit **100**, corresponding to grayscales (e.g., 10 Gray, 60 Gray, . . . , and 255 Gray) displayed at each of dimming levels DEV**1**, . . . , and DEVp and temperatures (e.g., 0° C., 10° C., . . . , 40° C., 50° C., . . .) of each of the grayscales as shown in FIG. **4**, may be stored in the look-up table LUT. In an example, gamma values GMR, GMG, and GMB corresponding to grayscales (e.g., 10 Gray, 60 Gray, . . . , and 255 Gray) displayed at each of dimming levels DEV**1**, . . . , and DEVp and temperatures (e.g., 0° C., 10° C., . . . , 40° C., 50° C., . . .) of each of the grayscales as shown in FIG. **6** may be stored in the look-up table LUT.

When the look-up table LUT is included in the timing controller **120***a* and an initial gamma value is stored in the storage unit **122** during a manufacturing process, the control device **200** shown in FIG. **3** may be omitted. That is, the control device **200** may be replaced with the timing controller **120***a*. To this end, processing data respectively corresponding to grayscales Gray included in a dimming level

DEV, a processing gamma value, and the like may be additionally stored in the storage unit **122**.

A process of setting gamma values GMR, GMG, and GMB using the timing controller **120***a* during the manufacturing process is substantially the same as described in FIGS. **5** and **7**, and accordingly, detailed descriptions will be omitted.

FIG. **9** is a diagram illustrating an embodiment of the pixel shown in FIG. **1**.

Referring to FIG. **9**, a pixel PXij may include transistors T**11**, T**12**, T**13**, T**14**, T**15**, T**16**, and T**17**, a storage capacitor Cst, and a light emitting element LD.

Hereinafter, a circuit implemented with a P-type transistor is described as an example. However, those skilled in the art may design a circuit implemented with an N-type transistor by changing the polarity of a voltage applied to a gate terminal. Similarly, those skilled in the art may design a circuit implemented with a combination of the P-type transistor and the N-type transistor. The transistor may have various forms including a Thin Film Transistor (TFT), a Field Effect Transistor (FET), a Bipolar Junction Transistor (BJT), and the like.

A gate electrode of an eleventh transistor T**11** may be connected to a first node N**1**, a first electrode of the eleventh transistor T**11** may be connected to a second node N**2**, and a second electrode of the eleventh transistor T**11** may be connected to a third node N**3**. The eleventh transistor T**11** may be referred to as a driving transistor.

A gate electrode of a twelfth transistor T**12** may be connected to a scan line SLi**1**, a first electrode of the twelfth transistor T**12** may be connected to a data line DLj, and a second electrode of the twelfth transistor T**12** may be connected to the second node N**2**. A gate electrode of a thirteenth transistor T**13** may be connected to a scan line SLi**2**, a first electrode of the thirteenth transistor T**13** may be connected to the first node N**1**, and a second electrode of the thirteenth transistor T**13** may be connected to the third node N**3**.

A gate electrode of a fourteenth transistor T**14** may be connected to a scan line SLi**3**, a first electrode of the fourteenth transistor T**14** may be connected to the first node N**1**, and a second electrode of the fourteenth transistor T**14** may be connected to an initialization line INTL. A gate electrode of the fifteenth transistor T**15** may be connected to a kth emission control line ELk, a first electrode of the fifteenth transistor T**15** may be connected to a first power line PL**1**, and a second electrode of the fifteenth transistor T**15** may be connected to the second node N**2**.

A gate electrode of the sixteenth transistor T**16** may be connected to the kth emission control line ELk, a first electrode of the sixteenth transistor T**16** may be connected to the third node N**3**, and a second electrode of the sixteenth transistor T**16** may be connected to an anode of the light emitting element LD. In an embodiment, the fifteenth transistor T**15** and the sixteenth transistor T**16** may be connected to different emission control lines.

A gate electrode of a seventeenth transistor T**17** may be connected to a scan line SLi**4**, a first electrode of the seventeenth transistor T**17** may be connected to the initialization line INTL, and a second electrode of the seventeenth transistor T**17** may be connected to the anode of the light emitting element LD. A first electrode of the storage capacitor Cst may be connected to the first power line PL**1**, and a second electrode of the storage capacitor Cst may be connected to the first node N**1**.

The anode of the light emitting element LD may be connected to the second electrode of the sixteenth transistor T**16**, and a cathode of the light emitting element LD may be connected to a second power line PL**2**. The light emitting element LD may be a light emitting diode. The light emitting element LD may be configured as an organic light emitting diode, an inorganic light emitting diode, a quantum dot/well light emitting diode, or the like. The light emitting element LD may emits light of any one color among a first color, a second color, and a third color. In addition, in this embodiment, only one light emitting element LD is provided in each pixel. However, in another embodiment, a plurality of light emitting elements may be provided in each pixel. The plurality of light emitting elements may be connected in series, parallel, series/parallel, or the like.

A voltage of a first power source VDD may be applied to the first power line PL**1**, a voltage of a second power source VSS may be applied to the second power line PL**2**, and a voltage of an initialization power source may be applied to the initialization line INTL. For example, the voltage of the initialization power source may be equal to or higher than the voltage of the second power source VSS. For example, the voltage of the initialization power source may be equal to or higher than the voltage of the second power source VSS. For example, the voltage of the initialization power source may correspond to a data voltage having the smallest magnitude among magnitudes of data voltages which can be provided. In another example, the magnitude of the voltage of the initialization power source may be smaller than the magnitudes of the data voltages which can be provided.

FIG. **10** is a diagram illustrating an exemplary driving method of the pixel shown in FIG. **9**.

Hereinafter, for convenience of description, it is assumed that the scan lines SLi**1**, SLi**2**, and SLi**4** correspond to an ith scan line SLi, and the scan line SLi**3** corresponds to an (i−1) th scan line SLi−1. However, in some embodiments, a connection relationship between the scan lines SLi**1**, SLi**2**, SLi**3**, and SLi**4** may be altered. For example, the scan line SLi**4** may be an (i−1) th scan line or an (i+1) th scan line.

First, an emission control signal having a turn-off level (logic high level) is applied to the kth emission control line ELk, a data signal DATA(i−1)j for an (i−1) th pixel is applied to the data line DLj, and a scan signal having a turn-on level (logic low level) is applied to the scan line SLi**3**. High/low of a logic level may be changed according to whether a transistor is of a P-type or an N-type.

Since a scan signal having the turn-off level is applied to the scan lines SLi**1** and SLi**2**, the twelfth transistor T**12** is in a turn-off state, and the data signal DATA(i−1)j for the (i−1) th pixel is prevented from being input to the pixel PXij.

Since the fourteenth transistor T**14** is in a turn-on state, the first node N**1** is connected to the initialization line INTL, so that a voltage of the first node N**1** is initialized. Since the emission control signal having the turn-off level is applied to the emission control line ELk, the transistors T**15** and T**16** are in the turn-off state, and unnecessary emission of the light emitting element LD in a process of applying the voltage of the initialization power source is prevented.

Next, a data signal DATAij for an ith pixel PXij is applied to the data line DLj, and the scan signal having the turn-on level is applied to the scan lines SLi**1** and SLi**2**. Accordingly, the transistors T**12**, T**11**, and T**13** are turned on, and the data line DLj and the first node N**1** are electrically connected to each other. Therefore, a compensation voltage obtained by subtracting a threshold voltage of the eleventh transistor T**11** from the data signal DATAij is applied to the second electrode of the storage capacitor Cst (i.e., the first node N**1**), and the storage capacitor Cst maintains a voltage corresponding to the difference between the voltage of the first power source VDD and the compensation voltage. Such a period may be referred to as a threshold voltage compensation period or a data writing period.

In addition, when the scan line SLi4 is the ith scan line, the seventeenth transistor T17 is in the turn-on state. Hence, the anode of the light emitting element LD and the initialization line INTL are connected to each other, and the light emitting element LD is initialized to a charge amount corresponding to the voltage difference between the voltage of the initialization power source and the voltage of the second power source VSS.

After that, as the emission control signal having the turn-on level is applied to the kth emission control line ELk, the transistors T15 and T16 may be electrically connected to each other. Therefore, a driving current path is formed, through which the first power line PL1, the fifteenth transistor T15, the eleventh transistor T11, the sixteenth transistor T16, the light emitting element LD, and the second power line PL2 are connected to each other.

An amount of driving current flowing through the first electrode and the second electrode of the eleventh transistor T11 is adjusted according to the voltage maintained in the storage capacitor Cst. The light emitting element LD emits light with a luminance corresponding to the amount of driving current. The light emitting element LD emits light until before the emission control signal having the turn-off level is applied to the emission control line ELk.

When an emission control signal has the turn-on level, pixels receiving the corresponding emission control signal may be in a display state. Therefore, the period in which the emission control signal has the turn-on level may be referred to as an emission period EP (or emission allow period). In addition, when an emission control signal has the turn-off level, pixels receiving the corresponding emission control signal may be in a non-display state. Therefore, the period in which the emission control signal has the turn-off level may be referred to as a non-emission period NEP (or emission inhibit period).

The non-emission period NEP described in FIG. 10 is used to prevent the pixel PXij from emitting light with an unwanted luminance during the initialization period and the data write period.

One or more non-emission periods NEP may be additionally provided while a data signal written to the pixel PXij is maintained (e.g., one frame period). This is for the purpose of reducing the emission period EP of the pixel PXij, thereby effectively expressing a low grayscale or gently blurring motion of an image.

In the display device and the gamma voltage setting method thereof in accordance with the present disclosure, a gamma voltage (or gamma value) can be set by reflecting a temperature characteristic during a manufacturing process, and accordingly, the display quality of the display device can be improved.

Example embodiments have been disclosed herein, and although specific terms are employed, they are used and are to be interpreted in a generic and descriptive sense only and not for purpose of limitation. In some instances, as would be apparent to one of ordinary skill in the art as of the filing of the present application, features, characteristics, and/or elements described in connection with a particular embodiment may be used singly or in combination with features, characteristics, and/or elements described in connection with other embodiments unless otherwise specifically indicated. Accordingly, it will be understood by those of skill in the art that various changes in form and details may be made without departing from the spirit and scope of the present disclosure as set forth in the following claims.

What is claimed is:

1. A gamma voltage setting method of a display device, comprising:
   - supplying, to a data driver, data corresponding to a specific grayscale of a specific dimming level;
   - generating a data signal corresponding to the data in the data driver using a gamma voltage corresponding to a processing gamma value;
   - displaying an image corresponding to the data signal in a pixel unit;
   - determining a temperature of the pixel unit;
   - loading, from a look-up table, a target luminance and a target color coordinate, which correspond to the specific dimming level, the specific grayscale, and the temperature of the pixel unit;
   - generating a gamma value such that an image corresponding to the target luminance and the target color coordinate is displayed in the pixel unit; and
   - storing the gamma value.

2. The gamma voltage setting method of claim 1, wherein the gamma value is stored in the display device during a manufacturing process of the display device.

3. The gamma voltage setting method of claim 1, wherein the gamma value includes a first gamma value corresponding to a pixel of a first color, a second gamma value corresponding to a pixel of a second color, and a third gamma value corresponding to a pixel of a third color.

4. The gamma voltage setting method of claim 1, wherein a plurality of dimming levels, a plurality of grayscales included in each of the plurality of dimming levels, and the target luminance and the target color coordinate, which correspond to at least two different temperatures in each of the plurality of grayscales, are stored in the look-up table.

5. The gamma voltage setting method of claim 1, further comprising sensing whether the image corresponding to the target luminance and the target color coordinate is displayed in the pixel unit using a camera.

6. A gamma voltage setting method of a display device, comprising:
   - supplying, to a data driver, data corresponding to a specific grayscale of a specific dimming level;
   - generating a data signal corresponding to the data in the data driver using a gamma voltage corresponding to a processing gamma value;
   - displaying an image in a pixel unit corresponding to the data signal;
   - determining a temperature of the pixel unit;
   - loading, from a look-up table, a gamma value corresponding to the specific dimming level, the specific grayscale, and the temperature of the pixel unit; and
   - storing the gamma value.

7. The gamma voltage setting method of claim 6, wherein the gamma value is stored in the display device during a manufacturing process of the display device.

8. The gamma voltage setting method of claim 6, wherein the gamma value includes a first gamma value corresponding to a pixel of a first color, a second gamma value corresponding to a pixel of a second color, and a third gamma value corresponding to a pixel of a third color.

9. The gamma voltage setting method of claim 6, wherein a plurality of dimming levels, a plurality of grayscales included in each of the plurality of dimming levels, and the gamma value corresponding to at least two different temperatures in each of the plurality of grayscales are stored in the look-up table.

10. A display device comprising:

a pixel unit including pixels connected to scan lines and data lines;

a data driver configured to supply a data signal to the data lines;

a gamma voltage supplier configured to supply a gamma voltage to the data driver corresponding to a gamma value;

a timing controller including a storage unit configured to store the gamma value and a look-up table; and

a temperature sensor configured to sense a temperature of the pixel unit,

wherein a plurality of dimming levels, a plurality of grayscales included in each of the plurality of dimming levels, and gamma value setting information corresponding to at least two different temperatures in each of the plurality of grayscales are stored in the look-up table, and

wherein the gamma value setting information corresponds to a target luminance and a target color coordinate of the pixel unit which correspond to the different temperatures, or the gamma value corresponding to the different temperatures.

11. The display device of claim 10, wherein the gamma value includes a first gamma value corresponding to a pixel of a first color, a second gamma value corresponding to a pixel of a second color, and a third gamma value corresponding to a pixel of a third color.

12. The display device of claim 10, wherein the timing controller:

displays an image corresponding to a specific grayscale of a specific dimming level in the pixel unit during a manufacturing process; and

stores, in the storage unit, the gamma value corresponding to the specific grayscale of the specific dimming level and a target luminance and a target color coordinate, which correspond to a temperature of the pixel unit, which is measured from the temperature sensor.

13. The display device of claim 10, wherein the timing controller:

displays an image corresponding to a specific grayscale of a specific dimming level in the pixel unit during a manufacturing process; and

loads, from the look-up table, the gamma value corresponding to the specific grayscale of the specific dimming level and a temperature of the pixel unit, which is measured from the temperature sensor, and stores the gamma value in the storage unit.

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