(54) Title of the Invention: Display device, display correction device, display correction system, and display correction method

Abstract Title: Display device, display correction device, display correction system, and display correction method

(57) The present invention relates to a display device, a display correction device, a display correction system, and a display correction method. The display correction system may include: a display device for displaying a pattern image; a camera for photographing the displayed pattern image; an image analysis unit for calculating RGB values of the photographed pattern image; and a characteristic correction unit for generating correction data to enable each pixel to display the calculated average value on the basis of an average value of the calculated RGB values and an RGB value of each pixel.
START

100 DISPLAY AND CAPTURE RGB PATTERN IMAGE

110 CALCULATE RGB AVERAGE VALUE OF CAPTURED RGB PATTERN IMAGE

120 CALCULATE CORRECTION DATA BASED ON RGB VALUE OF EACH PIXEL AND CALCULATED AVERAGE VALUE

130 RGB PATTERN IMAGE IS NTH PATTERN IMAGE?

140 LOAD NEXT TURN OF RGB PATTERN IMAGE

TRANSMIT CALCULATED CORRECTION DATA TO DISPLAY APPARATUS

STORE TRANSMITTED CORRECTION DATA IN MEMORY

DISPLAY IMAGE ON DISPLAY UNIT BASED ON STORED CORRECTION DATA

END
[Fig. 5]

START

DISPLAY AND CAPTURE RGB PATTERN IMAGE

LOAD NEXT TURN OF RGB PATTERN IMAGE

CALCULATE AVERAGE VALUE OF PREDETERMINED DIVISION REGION AMONG CAPTURED RGB PATTERN IMAGE

RE-SET DIVISION REGION BASED ON RGB VALUE

CALCULATE CORRECTION DATA BASED ON RGB VALUE OF EACH PIXEL AND CALCULATED RGB AVERAGE VALUE OF THE PREDETERMINED DIVISION REGION

RGB PATTERN IMAGE IS NTH PATTERN IMAGE?

YES

TRANSMIT CALCULATED CORRECTION DATA TO DISPLAY APPARATUS

STORE TRANSMITTED CORRECTION DATA IN MEMORY

DISPLAY IMAGE ON DISPLAY UNIT BASED ON STORED CORRECTION DATA

NO

S200

S210

S220

S230

S240

S250

S260

S270

S280

END
START

DISPLAY AND CAPTURE RGB PATTERN IMAGE

CALCULATE AVERAGE VALUE OF FIRST REGION OF PREDETERMINED DIVISION REGION AMONG CAPTURED RGB PATTERN IMAGE

LOAD NEXT TURN OF RGB PATTERN IMAGE

ESTIMATE RGB VALUE OF SECOND REGION OF PREDETERMINED DIVISION REGION

RE-SET DIVISION REGION BASED ON RGB VALUE

CALCULATE CORRECTION DATA BASED ON RGB VALUE OF EACH PIXEL AND CALCULATED AVERAGE VALUE

RGB PATTERN IMAGE IS NTH PATTERN IMAGE?

NO

YES

TRANSMIT CALCULATED CORRECTION DATA TO DISPLAY APPARATUS

STORE TRANSMITTED CORRECTION DATA IN MEMORY

DISPLAY IMAGE ON DISPLAY UNIT BASED ON STORED CORRECTION DATA

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[Fig. 12b]

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START

DISPLAY AND CAPTURE POSITION PATTERN IMAGE

RECOGNIZE POSITION OF PIXEL ON DISPLAY UNIT BY COMPARING DISPLAYED POSITION PATTERN IMAGE WITH CAPTURED POSITION PATTERN IMAGE

DISPLAY AND CAPTURE RGB PATTERN IMAGE

CALCULATE RGB AVERAGE VALUE OF RGB PATTERN IMAGE BASED ON RECOGNIZED POSITION OF PIXEL

RGB PATTERN IMAGE IS NTH RGB PATTERN IMAGE?

YES

TRANSMIT CALCULATED CORRECTION DATA TO DISPLAY APPARATUS

STORE TRANSMITTED CORRECTION DATA IN MEMORY

DISPLAY IMAGE ON DISPLAY UNIT BASED ON STORED CORRECTION DATA

END

LOAD NEXT TURN OF RGB PATTERN IMAGE

NO

$S400$

$S410$

$S420$

$S430$

$S440$

$S450$

$S460$

$S470$

$S480$
<NOTIFICATION>
DISPLAY CORRECTION SIGNAL DETECTED
WANT TO CORRECT?

YES  NO
[DESCRIPTION]

[Invention Title]

DISPLAY DEVICE, DISPLAY CORRECTION DEVICE, DISPLAY CORRECTION SYSTEM, AND DISPLAY CORRECTION METHOD

5  【Technical Field】

Embodiments of the present disclosure relate to a display apparatus, a display correction apparatus, a display correction system and a display correction method to correct characteristics of a displayed image.

【Background Art】

10  As a liquid crystal display apparatus (LCD) becomes larger and curved, the size and the occurrence frequency of mura defeat i.e., contrast-type defects and image quality distortion, are increased. The term mura refers to a smudge in Japanese, which means a defeat in a certain region in the shape of a point, a line or a surface displayed differently in brightness or color than surrounding regions when an entire screen is displayed with a constant gray scale.

Mura may be generated in a process of implementing a LCD panel in a display apparatus or a process of curving a flat LCD panel to a curved LCD panel. Particularly, mura may be generated by the uniformity of the thickness of the liquid crystal, the stress distribution, the temperature distribution, the positional orientation characteristic of the polarizing film, and the difference in the thickness or the width of the transparent electrode circuit and it may cause a case in which a different output is displayed although the same input signal is supplied to a display apparatus. Further, mura may be generated in the manufacturing process, in the applying the manufactured panel to a display apparatus, or by heat generated by a light source of a backlight in the complete product. Therefore, as for the display apparatus, an operation is required to correct the mura after gamma correction before shipment or during manufacture.
As for the correction of the mura, a method of correcting only mura area that is detected by capturing a pattern image may require a large amount of calculation, and thus a period of time to correct mura may be increased. In addition, in correcting the mura correction, it is necessary to perform a lot of calculation to correct only a mura region that is generated by detecting the mura by capturing a pattern image, and there is a problem that the mura correction time is prolonged. In addition, using a high-resolution camera to remove moiré pattern when capturing the pattern image, may cause increasing the price of a display correction apparatus. Therefore, recently, researches for correcting the mura defects have been actively conducted.

【Disclosure】

【Technical Problem】

Therefore, it is an aspect of the present disclosure to provide a display apparatus, a display correction apparatus, a display correction system and a display correction method that corrects a displayed RGB value to a uniform RGB value without detecting mura.

【Technical Solution】

In accordance with an aspect of the present disclosure, there is provided a display correction apparatus includes a camera configured to capture a pattern image displayed on a display apparatus; an image analyzer configured to calculate an RGB value of the captured pattern image; and a characteristic corrector configured to correct the display apparatus based on the calculated RGB average value and RGB value of each pixel so that each pixel displays a calculated average value.

Here, the characteristic corrector corrects the display apparatus based on an RGB average value of a predetermined certain region and the RGB value of each pixel.

Also, the characteristic corrector corrects the display apparatus based on an
RGB average value of a plurality of predetermined division regions and the RGB value of each pixel.

Also, the image analyzer calculates an RGB value of a first region among the plurality of predetermined division regions, and estimates an RGB value of a second region in the predetermined division region based on the calculated RGB value.

Also, the image analyzer estimates an RGB value of a first region included in another predetermined division region adjacent to one predetermined division region including the second region to be estimated, and an RGB value of a first region included in the one predetermined division region, by using the linear interpolation method.

Also, the camera captures the pattern image without focusing on the pattern image.

In accordance with an aspect of the present disclosure, there is provided a display apparatus includes a display unit configured to display a pattern image; and a memory configured to store the displayed pattern image and a correction data allowing pixels of the display unit to display a uniform RGB value.

Here, the pattern image comprises a position pattern image used for matching a position of an image displayed on the display unit with a position of an image captured by a camera, and an RGB pattern image used for generating a correction data allowing pixels of the display unit to display a uniform RGB value.

Also, a communication unit configured to receive the correction data calculated by an external display correction apparatus, via at least one of wired communication and wireless communication.

Also, the correction data comprises a correction value of a predetermined certain region and a deviation of another region.

In accordance with an aspect of the present disclosure, there is provided a display correction system includes a display apparatus configured to display a pattern image; and a display correction apparatus comprising a camera capturing the displayed pattern image, an image analyzer calculating an RGB value of the captured pattern image, and a characteristic corrector generating a correction data allowing each pixel to display a calculated average value based on the calculated RGB average value and the RGB value of each pixel.
Also, the characteristic corrector generates a correction data based on the RGB average value of a predetermined certain region and the RGB value of each pixel.

Also, the characteristic corrector generates a correction data based on the RGB average value of a plurality of predetermined division regions and the RGB value of each pixel.

Also, the image analyzer calculates an RGB value of a first region among a plurality of predetermined division regions, and estimates an RGB value of a second region in the predetermined division region based on the calculated RGB value.

Also, the image analyzer estimates an RGB value of the second region based on an RGB value of a first region included in another predetermined division region adjacent to one predetermined division region including the second region to be estimated, and an RGB value of a first region included in the one predetermined division region, by using the linear interpolation method.

Also, when the another predetermined division region is not present on one side of the one predetermined division region, the image analyzer estimates an RGB value of the second region by expanding the one predetermined division region to one side.

Also, when the another predetermined division region is not present on one side of the one predetermined division region, the image analyzer estimates an RGB value of the second region by expanding an RGB value of the first region included in the one predetermined division region, to one side.

Also, the RGB value expanded to the one side is an RGB average value of the first region included in the one predetermined division region.

Also, the predetermined division region is re-set by grouping pixels according to a pre-calculated RGB value within a predetermined range.

Also, the pattern image comprises a position pattern image used for matching a position of an image displayed on the display apparatus with a position of an image captured by a camera and an RGB pattern image used for generating a correction data allowing pixels of the display apparatus to display a uniform RGB value.

Also, the RGB pattern image represents a plurality of RGB pattern images in which an R value, a G value and a B value have a different value with a
predetermined ratio.

Also, the plurality of RGB pattern images represents that an R value, a G value and a B value are the same in one RGB pattern image but an R value, a G value and a B value have a different value in another RGB pattern image.

Also, the plurality of RGB pattern images comprises an RGB pattern image in which any one of an R value, a G value and a B value is different and the rest thereof are the same.

Also, the correction data is calculated by corresponding to the plurality of RGB pattern images.

Also, the camera captures the pattern image without focusing on the pattern image.

Also, the correction data comprises a correction value of a predetermined certain region and a deviation of another region.

Also, the display apparatus further comprises a communication unit configured to receive the correction data calculated by the characteristic corrector, via at least one of wired communication and wireless communication.

In accordance with an aspect of the present disclosure, there is provided a display correction method includes displaying a pattern image; calculating an RGB value of the captured pattern image by capturing the displayed pattern image; and correcting to allow each pixel to display a calculated average value based on the calculated RGB average value and RGB value of each pixel.

Here, the correction is performed based on the RGB average value of a predetermined certain region and the RGB value of each pixel.

Also, the correction is performed based on the RGB average value of a plurality of predetermined division regions and the RGB value of each pixel.

Also, the calculation of an RGB value calculates an RGB value of a first region among the plurality of predetermined division regions, and estimates an RGB value of a second region in the predetermined division region based on the calculated RGB value.

Also, the RGB value of the second region is estimated based on an RGB value of a first region included in another predetermined division region adjacent to one predetermined division region including the second region to be estimated, and
an RGB value of a first region included in the one predetermined division region, by using the linear interpolation method.

Also, the predetermined division region is re-set by grouping pixels according to a pre-calculated RGB value within a predetermined range.

Also, the pattern image comprises a position pattern image used for matching a position of the displayed image with a position of the captured image and an RGB pattern image used for correcting to allow each pixel of the display apparatus to display a uniform RGB value.

【Advantageous Effects】

As is apparent from the above description, according to the proposed display apparatus, display correction apparatus, display correction system and display correction method, it may be possible to correct a display apparatus without detecting mura by using a high performance camera, so that the display apparatus displays a uniform RGB value without changing a gamma curve.

【Description of Drawings】

These and/or other aspects of the present disclosure will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a block diagram illustrating a configuration of a display correction system in accordance with one embodiment.

FIG. 2A is a view illustrating an appearance of the display correction system in accordance with one embodiment.

FIG. 2B is a view illustrating an appearance of a display correction system in accordance with another embodiment.

FIG. 2C is a view illustrating an appearance of a display correction system in accordance with alternate another embodiment.
FIG. 3 is a block diagram illustrating a configuration of a display correction system generating a correction data according to the embodiment A.

FIG. 4 is a flowchart illustrating a method for generating a correction data according to the embodiment A1.

FIG. 5 is a flowchart illustrating a method for generating a correction data according to the embodiment A2.

FIG. 6 is a view illustrating a concept of generating a correction data according to the embodiment A3.

FIG. 7 is a block diagram illustrating a display correction system 1 generating a correction data 910 according to the embodiment B.

FIG. 8 is a flowchart illustrating a method for generating a correction data according to the embodiment B1.

FIG. 9 is a view illustrating a concept of generating a correction data according to the embodiment B2.

FIG. 10 is a view illustrating a concept of generating a correction data according to the embodiment B3.

FIG. 11 is a view illustrating a concept of generating a correction data according to the embodiment B4.

FIG. 12A is a view illustrating a process of generating the correction data 910 through a matrix according to one embodiment.

FIG. 12B is a view illustrating a process of generating the correction data 910 through a matrix according to another embodiment.

FIG. 13 is a flowchart illustrating a method for generating a correction data according to embodiment C.

FIGS. 14A illustrates an embodiment of a position pattern image.
FIGS. 14B illustrates another embodiment of a position pattern image.

FIGS. 14C illustrates another embodiment of a position pattern image.

FIGS. 14D illustrates another embodiment of a position pattern image.

FIGS. 14E illustrates another embodiment of a position pattern image.

FIGS. 14F illustrates another embodiment of a position pattern image.

FIGS. 14G illustrates another embodiment of a position pattern image.

FIG. 15A is a graph illustrating a distribution of an RGB value of the display apparatus before correction in accordance with one embodiment.

FIG. 15B is a graph illustrating a distribution of an RGB value of the display apparatus after correction in accordance with one embodiment.

FIG. 16A is a graph illustrating a distribution of an RGB value of the display apparatus before correction in accordance with another embodiment.

FIG. 16B is a graph illustrating a distribution of an RGB value of the display apparatus after correction in accordance with another embodiment.

FIG. 17 is a perspective view illustrating a display correction system generating a correction data in a display correction apparatus.

【Best Mode】

The present disclosure will now be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the disclosure are shown. In the description of the present disclosure, if it is determined that a detailed description of commonly-used technologies or structures related to the embodiments of the present disclosure may unnecessarily obscure the subject matter of the present disclosure, the detailed description will be omitted.

The terms used below are terms selected in consideration of functions in the embodiments, and the meaning of the terms may vary depending on, the intention of
the user and the operator or precedent cases. Therefore, the meaning of the terms used in the following embodiments are defined according to their definitions when they are specifically defined below, and when there is no specific definition, they should be construed as having meanings that are obvious to one of ordinary skill in the art.

In addition, although the aspect of the embodiments selectively described or the configurations of the embodiments selectively described is illustrated as a single integrated configuration in the drawings, it should be understood that the configuration is combined with each other unless the technical details are apparent to those of ordinary skill in the art.

Hereinafter exemplary embodiments of a display apparatus, a display correction apparatus, a display correction system and a display correction method will be described with reference to the drawings.

Hereinafter one embodiment of a configuration of a display correction system will be described with reference to FIGS. 1 to 2C.

FIG. 1 is a block diagram illustrating a configuration of a display correction system.

A display correction system 1 may capture a pattern image 950 displayed on a display apparatus 600, compare RGB values of the captured image, and equalize each pixel of the display apparatus 600 to a certain RGB value. In addition, the display correction system 1 may equalize each pixel of the display apparatus 600 to a certain RGB value by measuring an RGB value of a part of the pattern image 950 displayed on a display and estimating the remaining part of the pattern image 950.

Particularly, the display correction system 1 may include a display correction apparatus 100 configured to generate a correction data 910 by capturing the pattern image 950 and configured to correct an RGB value of an image displayed on the display apparatus 600; and the display apparatus 600 configured to display the pattern image 950 and configured to receive the correction data 910 from the display correction apparatus 100 and store the correction data 910.

The display correction apparatus 100 may capture the pattern image 950 displayed on the display apparatus 600 to generate the correction data 910.
configured to correct an RGB value of the captured pattern image 950 to a uniform RGB value.

Particularly, the display correction apparatus 100 may capture a position pattern image 960, calculate a deviation between a displayed position pattern image 960 and a captured position pattern image 960, capture an RGB pattern image 980, generate the correction data 910 to equalize an RGB value of each pixel of the display apparatus 600 to a certain RGB value, and correct the display apparatus 600. In addition, the display correction apparatus 100 may include a camera 200, a sampling unit 250, an image analyzer 300, a characteristic corrector 400, and a first communication unit 500.

The camera 200 may capture the pattern image 950 displayed on the display apparatus 600 and convert the captured pattern image 950 into an image signal. In addition, the camera 200 may detect capturing environment at a time of capturing the pattern image 950 and then transmit the capturing environment to the image analyzer 300. For example, the camera 200 may detect an exposure time, a sensitivity (ISO) and an aperture value (F#), and transmit the exposure time, sensitivity (ISO) and aperture value (F#) to the image analyzer 300.

When capturing the pattern image 950, the camera 200 may expose the pattern image 950 with a predetermined exposure time or longer. Particularly, banding noise or flicker may occur in the captured pattern image 950 due to a change in illuminance or the scan rate around the display apparatus 600 and in addition, the noise may be increased despite of increasing the sensitivity when capturing a dark image. Accordingly, the exposure time may be needed to be longer than a predetermined time. For example, the exposure time needs to be equal to or longer than 0.0005 second.

In addition, the camera 200 may be placed in a position far from the display apparatus 600 with a certain distance, and the distance from the display apparatus 600 and the size or the shape of the display apparatus 600 may be variable. When a distance between the display apparatus 600 to be corrected and the camera 200 is constant and when the correction data 910 is generated by capturing the same display apparatus 600, the correction data 910 may be generated by using a predetermined position data without capturing the position pattern image 960.
However, the distance between the display apparatus 600 to be corrected and the camera 200 is not constant or the shape of the display apparatus 600 is not constant, the display correction system 1 may need to perform an operation of capturing the position pattern image 960 and calculating a deviation between a displayed position pattern image 960 and a captured position pattern image 960.

A high performance camera having a high resolution may be used as the camera 200, but a low performance camera having a low resolution may be used as the camera 200. The high performance camera 200 may represent a camera having more than five times pixel than pixel included in the display apparatus 600 to be captured, and the low performance camera 200 may represent a camera having less than five times pixel than pixel included in the display apparatus 600 to be captured. In addition, CCD and CMOS using Si semiconductor may be used as a sensor of the camera 200, but is not limited thereto. A variety of sensors may be used for the sensor of the camera 200.

When capturing the pattern image 950, the camera 200 may capture the pattern image 950 while focusing on a front surface or a rear surface of the pattern image 950 without focusing on the pattern image 950.

An RGB camera 200 configured to recognize all of an R value, a G value and a B value or a mono camera 200 configured to recognize any one of an R value, a G value and a B value may be used as the camera 200. Depending on the type of the camera 200 (i.e. the RGB camera 200 or the mono camera 200), the type or the number of RGB pattern image 980 to be captured may be determined.

Alternatively, a digital camera 200 or an analog camera 200 e.g. a film camera 200 or a polaroid camera 200 may be used as the camera 200, wherein a scanner is required to use the analog camera 200 to convert a captured image to a digital signal. Alternatively, a mobile electronic device having the camera 200 may capture the pattern image 950 and generate the correction data 910 by using an application processor (AP). Further, the camera 200 may be a camera module. The camera 200 may be fixed to a tripod to fix the position of the camera 200 and to prevent the camera 200 from being moved.

The sampling unit 250 may calculate an RGB value of a part of the display apparatus 600 displaying the pattern image 950 to be captured and transmit the
calculated RGB value to the image analyzer 300 so that the image analyzer 300 estimates an RGB value of the remaining part of the display apparatus 600. In addition, the sampling unit 250 may determine a predetermined division region by grouping a region according to a similarity of an RGB value of previously measured pattern image 950 and an estimated RGB value. Particularly, the sampling unit 250 may set the predetermined division region by grouping pixel having an RGB value within a predetermined range.

The image analyzer 300 may receive the captured pattern image 950 or an RGB value sampled by the sampling unit 250, map a deviation between the displayed pattern image 950 and the captured pattern image 950, and map an RGB value of each pixel. In addition, the image analyzer 300 may estimate an RGB value of pixel included in a region that is not sampled, based on the sampled RGB value.

Particularly, the image analyzer 300 may include a position pattern mapping unit 310, an RGB pattern mapping unit 320 and an RGB estimator 330.

The position pattern mapping unit 310 may analyze an image signal of the captured position pattern image 960 that is stored in the memory 900 of the display apparatus 600 to measure a deviation between the displayed position pattern image 960 and the captured position pattern image 960.

Particularly, the position pattern mapping unit 310 may extract feature points of the position pattern image 960 based on a pattern of the position pattern image 960 and then extract a distance and a direction between a feature point of the position pattern image 960 displayed on a display unit 1000 and stored in the memory 900 and a feature point of the captured position pattern image 960.

For example, when capturing the position pattern image 960 displayed on the display apparatus 600 having the curved shape, from the front side in a two dimensions, the captured position pattern image 960 may have a sandglass shape on a plane. That is, the captured position pattern image 960 may have a shape in which a vertical side has a straight line, a horizontal side has a curved line, and a height of the center of the horizontal side is less than a height of opposite sides of the horizontal side. In this case, when performing a correction by displaying the RGB pattern image 980, a pixel placed in an irrelevant position may be corrected. Therefore, the position pattern mapping unit 310 may calculate a deviation the
displayed position pattern image 960 and the captured position pattern image 960 and then consider the deviation when generating the correction data 910.

The RGB pattern mapping unit 320 may map an RGB value displayed on each pixel of the display unit 1000 based on the image signal of the captured RGB pattern image 980.

The RGB value may represent a combination of an R value corresponding to red color, a G value corresponding to green color, and a B value corresponding to blue color among three distribution of the color. The RGB value may illustrate the color and the RGB value may illustrate brightness in a gray image in which an R value, a G value and a B value have the same value.

Particularly, the RGB pattern mapping unit 320 may calculate an RGB value of all of pixel of the display unit 1000 or an RGB value of a certain region that is sampled by the sampling unit 250.

The RGB estimator 330 may estimate an RGB value of a second region included in the predetermined division region based on an RGB value of a first region that is generated such that a pattern image 950 of a first region included in the predetermined division region is sampled by the sampling unit 250 and calculated by the RGB pattern mapping unit 320.

The predetermined division region may represent a region of a group generated by grouping each pixel of the display correction apparatus 100 into a plurality of groups, and the predetermined division region may be plural. Alternatively, the predetermined division region may be a division region that is grouped according the similarity range having an RGB value in a certain range based on an RGB value of a previous other RGB pattern image 980. The first region included in the predetermined division region may be a region sampled by the sampling unit and set to a region where the probability of occurrence of the mura is statistically low, or a region appropriate for estimating the RGB value of the second region. Further, the predetermined certain region may represent a certain region set to a region where the probability of occurrence of the mura is statistically low, and the predetermined certain region may be a single or plural.

Particularly, the RGB estimator 330 may estimate an RGB value of the second region by using the linear interpolation method based on an RGB value of the first
region included in one predetermined division region including the second region to be estimated, and an RGB value of a first region included in another predetermined division region placed in the surrounding of the one predetermined division region.

When another predetermined division region adjacent to the one predetermined division region including the second region to be estimated is insufficient to be estimated by using the linear interpolation method, the RGB estimator 330 may estimate the RGB value of the second region by expanding the RGB value of the one predetermined division region or an RGB average value of the first region. A detailed description of estimating the RGB values of the second area by extending the RGB values will be described below with reference to FIG. 11.

In addition, the RGB estimator 330 may map an RGB value by using the linear interpolation method based on an RGB that is generated by mapping an RGB pattern having a different level among the plurality of RGB pattern images 980 that is generated by mapping RGB values displayed on the display unit 1000.

The characteristic corrector 400 may correct a value output from the display apparatus 600 or generate the correction data 910 for correcting the value based on the deviation and the RGB value of the captured pattern image 950 mapped by the image analyzer 300.

Particularly, the characteristic corrector 400 may generate the correction data 910 for equalizing RGB values output from the display apparatus based on the RGB values of the pattern image mapped by the image analyzer 300. The characteristic corrector 400 may generate the correction data 910 having the same R, G, and B values by using at least one of an R value, a G value, and a B value, or alternatively, the characteristic corrector 400 may generate the correction data 910 based on a weight of each of the R value, the G value, and the B value. In addition, the characteristic corrector 400 may generate the correction data 910 so that an average value of the R value, the G value, and the B value is displayed when the difference between the RGB values of the mapped pixels is equal to or less than a predetermined value.

The characteristic corrector 400 may include an RGB comparator 410 and a correction data calculator 420.
The RGB comparator 410 may compare an RGB value calculated by the image analyzer 300 by corresponding to each pixel of the display unit 1000.

Particularly, the RGB comparator 410 may compare an RGB value of each pixel of the display unit 1000 with an RGB average value of all the pixels of the display unit 1000, and determine whether the RGB value of the corresponding pixel is larger or smaller than the RGB average value. In addition, the RGB comparator 410 may determine whether an RGB average value of a predetermined certain region of the display unit 1000 is larger or smaller than an RGB value of each pixel of the display unit 1000. The RGB comparator 410 may compare an RGB average value of a plurality of predetermined division regions with an RGB value of each pixel of the display unit 1000.

The correction data calculator 420 may generate the correction data 910 so that an RGB value of each pixel is displayed to be a reference RGB value based on an RGB value that is compared by the RGB comparator 410.

A detailed description of the correction data 910 for correcting the RGB values of each pixel by the correction data calculator 420 will be described below with reference to FIGS. 12A and 12B.

The first communication unit 500 may transmit the correction data 910 generated by the characteristic corrector 400 to the display apparatus 600. The first communication unit 500 may include a first communication module 510 and a first communication port 520.

The first communication module 510 may confirm whether a session with a second communication module 720 is completed and then transmit a communication signal for transmitting the correction data 910 to a second communication unit 700. The first communication module 510 may include a first wired communication module 511 and a first wireless communication module 512.

The first wired communication module 511 may determine whether a physical connection and an electrical connection are established between a first wired communication port 521 and the second wired communication port 711 and when the session is completed, the first wired communication module 511 may transmit the correction data 910 to the second wired communication module 721.
When the first wireless communication module 512 receives a signal for confirming a wireless session between a first wireless communication port 522 and the second wireless communication port 712 and when a paring thereof is completed, the first wireless communication module 512 may transmit the correction data 910 to the second wireless communication module 722.

particularly, the first wireless communication module 512 may include an antenna system, an RF transceiver, one or more amplifiers, a tuner, one or more oscillators, a digital signal processor, a CODEC chipset, a Subscriber Identity Module (SIM), and the like, but is not limited thereto. The first wireless communication module 512 may include a circuit well known in the art for performing those functions.

In addition, the first wireless communication module 512 may communicate with the second wireless communication module 722 and a network by using Internet, an intranet and a network which are called the World Wide Web (WWW), and / or a wireless network e.g., a cellular telephone network, a wireless LAN and / or a metropolitan area network (MAN), and a wireless communication.

The wireless communication may include Global System for Mobile Communication (GSM), Enhanced Data GSM Environment (EDGE), wideband code division multiple access (WCDMA), code division multiple access (CDMA), time division multiple access (TDMA) Bluetooth Low Energy (BLE), Near Field Communication (NFC), Zigbee, Wireless Fidelity (Wi-Fi) (e.g., IEEE 802.11a, IEEE 802.11b, IEEE 802.11g, and / or IEEE 802.11n, Voice over Internet Protocol (VoIP), Wi-MAX, Wi-Fi Direct, Ultra Wideband (UWB), infrared data association (IrDA), email, instant messaging and/or a protocol for short message service (SMS), or any other suitable communication protocol. In addition, various wireless communication methods may be used as an example of wireless communication.

In addition, at least one of the above-mentioned wireless communication methods may be used in the first wireless communication module 512 instead of using only one wireless communication method in the first wireless communication module 512.

The first communication port 520 may provide a path for transmitting data, which is to be transmitted from the first communication module 510 to the second
communication module 720, to the second communication module 720 via the second communication port 710. Further, the first communication port 520 may include the first wired communication port 521 providing a path of data transmitted from the first wired communication module 511 and the first wireless communication port 522 providing a path of data transmitted from the first wireless communication module 512.

The first communication port 520 may include a high-definition multimedia interface (HDMI) port, a Digital Video Interface (DVI) port, a D-subminiature (D-sub) port, a unshielded twisted pair cable (UTP cable) port and a Universal Serial Bus (USB) port. In addition, various communication ports for transmitting and receiving the correction data 910 of the characteristic corrector 400 may be used as an example of the first communication port 520.

The display apparatus 600 may receive the correction data 910 from the display correction apparatus 100, store the correction data 910 in the memory 900 and regulate an amount of light displayed on the pixel of the display unit 1000 using the correction data 910. The display apparatus 600 may also display the pattern image 950 so that the display correction apparatus 100 generates the correction data 910.

In addition, the display apparatus 600 may be in a state in which the manufacturing is completed but before shipment, or in a state in which the display panel is implemented in the display apparatus 600. The display apparatus 600 may be the display apparatus 600 in which gamma correction is completed.

Particularly, the display apparatus 600 may include the second communication unit 700, an input 750, a controller 800, the memory 900, and the display unit 1000.

The second communication unit 700 may receive the correction data 910 transmitted from the display correction apparatus 100 and transmit the correction data 910 to the controller 800 or the memory 900. In addition, the second communication unit 700 may include the second communication port 710 and the second communication module 720.

The second communication port 710 may provide a path for transmitting the correction data 910 transmitted from the first communication unit 500 to the second
communication module 720. In addition, the second communication port 710 may include the second wired communication port 711 and the second wireless communication port 712.

The type of the second communication port 710 may be identical to or different from the first communication port 520 described above.

The second communication module 720 may transmit the correction data 910 transmitted from the first communication unit 500 to the controller 800 or the memory 900 through the second communication port 710. In addition, the second communication module 720 may include the second wired communication module 721 and the second wireless communication module 722.

The second wired communication module 721 may receive the correction data 910 transmitted through the second wired communication port 711, receive a session signal transmitted by the first wired communication module 511, and transmit the session signal to the first wired communication module 511, again, thereby confirming a connection between the first wired communication port 521 and the second wired communication port 711.

The second wireless communication module 722 may receive the correction data 910 transmitted through the second wireless communication port 712, receive a session signal transmitted by the first wireless communication module 512 and transmit the session signal to the first wireless communication module 512, again, thereby confirming a connection between the first wireless communication port 522 and the second wireless communication port 712.

The type and method of the second wireless communication module 722 may be identical to or different from the type and method of the first wireless communication module 512 described above.

The input 750 may be a device configured to select a function of the display apparatus 600 and to input a command signal for performing a desired function. The input 750 may be a combination of buttons provided on the display apparatus 600 and a remote control device, e.g., a remote controller.

Particularly, the remote control device may control the display correction apparatus 100 and / or the display apparatus 600 using a short distance communication including infrared or Bluetooth. A user may control a function of the
display correction apparatus 100 and / or the display apparatus 600 by using a key (including a button) provided in the remote control device, a touch pad, a microphone capable of receiving a user's voice, or a sensor capable of recognizing a motion of the remote control device.

A user may turn on / off the power, change a channel, adjust a volume, select a terrestrial broadcast / cable broadcast / satellite broadcast, or perform a setting operation of the display apparatus 600 using the remote control device. In addition, the user may turn on / off the power, change the channel, adjust the volume, select a source or search content (e.g., application, video, web, and etc.) of the display apparatus 600 by using the remote control device.

The controller 800 may control overall operation of the display apparatus 600. That is, the controller 800 may receive the correction data 910 from the second communication unit 700, store the correction data 910 in the memory 900, adjust an RGB value of the display unit 1000 based on the correction data 910 and then select the broadcast or adjust the volume or the like based on an input signal of the input 750.

The controller 800 may function as a central processing unit, and the type of the central processing unit may be a microprocessor. The microprocessor may be a processor in which an arithmetic logic unit, a register, a program counter, a command decoder, and a control circuit are provided in at least one silicon chip.

The microprocessor may also include a graphics processor (GPU) for graphics processing of images or video. The microprocessor may be implemented as a system on chip (SoC) including a core and a GPU. The microprocessor may include single core, dual core, triple core, quad core and multiples thereof.

In addition, the controller 800 may include a graphic processing board including a GPU, RAM, or ROM on a separate circuit board that is electrically connected to the microprocessor.

Particularly, the controller 800 may include a main controller 820 and a display controller 810.

The main controller 820 may control overall control of the controller 800.

The main controller 820 may transmit a signal to the display controller 810 so that the display unit 1000 calls the pattern image 950 stored in the memory 900 and
displays the pattern image 950. The main controller 820 may receive the correction data 910 from the second communication unit 700 and store the correction data 910 in the memory 900. The main controller 820 may adjust the size of an input signal that is supplied to the display unit 1000 so that display controller 810 call the correction data 910 stored in the memory 900 to allow each pixel of the display unit 1000 to display the uniform RGB values. The main controller 820 may transmit a control signal to each configuration of the display apparatus 600 to perform a corresponding operation that is input by the display apparatus 600, based on an input signal of the input 750.

The display controller 810 may receive a control signal from the main controller 820 and transmit a control signal about a desired operation to the display unit 1000.

Particularly, the display controller 810 may transmit a control signal to the display unit 1000 so that the display unit 1000 displays the position pattern image 960 or the RGB pattern image 980. The display controller 810 may also adjust the control signal transmitted to the display unit 1000 so that each pixel of the display unit 1000 displays an RGB value designated by the correction data 910 based on the correction data 910.

Further, the display controller 810 may control the display unit 1000 so that correction data, which is configured to correct an R value, a G value, and a B value to be different from each other, is allowed to correct an R value, a G value, and a B value to a certain value. The display controller 810 may perform a correction about another value based on a correction data 910 related to at least one value among an R value, a G value, and a B value.

Particularly, it may be possible to perform the correction by using a less amount of data, when the correction data 910 about at least one value is stored without storing the correction data 910 about each of an R value, a G value, and a B value, due to limitations in the storage space of the memory 900 of the display apparatus 600, when it is insignificant to generate the correction data 910 about each of an R value, a G value, and a B value since a difference among an R value, a G value, and a B value displayed on each pixel of the display unit 1000 is significantly small, or when a data processing performance of the display correction
apparatus 100 calculating the correction data 910 or a data processing performance of the display apparatus 600 controlling the display unit 1000 based on the correction data 910 is insufficient.

For example, in a state in which an RGB value of the captured RGB pattern image 980 is equal to or less than a predetermined range, although an R value, a G value and a B value have a different value at the same level, the display apparatus 600 may correct the R value, the G value and the B value to the same value. When the display apparatus 600 has the correction data 910 about at least one of an R value, a G value and a B value, the display apparatus 600 may correct another value to the same value by expanding the correction data 910 of corresponding the value to the another value. When the display apparatus 600 has the correction data 910 about at least one of an R value, a G value and a B value, the display apparatus 600 may correct all of an R value, a G value and a B value so that the R value, the G value and the B value have a predetermined weight ratio.

The memory 900 may store the correction data 910 to allow an RGB value of the display correction apparatus 100 to be displayed as a reference RGB value, and store the pattern image 950 displayed on the display unit 1000 to generate the correction data 910 of the display.

The memory 900 may include a nonvolatile memory 900, e.g. ROM, a high-speed random access memory (RAM), magnetic disk storage devices, flash memory, or other nonvolatile semiconductor memory device.

For example, the memory 900 may be a semiconductor memory device, and thus as a Secure Digital (SD) memory card, Secure Digital High Capacity (SDHC) memory card, mini SD memory card, mini SDHC memory card, Trans Flash (TF) memory card, micro SD memory card, micro SDHC memory card, memory sticks, Compact Flash (CF), Multi-Media card (MMC), MMC micro, eXtreme (Digital XD) card may be used as the memory 900.

In addition, the memory 900 may include a network-attached storage device which is accessed via a network.

The correction data 910 may be a data generated by comparing an RGB value of each pixel of the display unit 1000 with the reference RGB value, and the
correction data 910 may be data in the form of a matrix. A detailed description of the correction data 910 will be described with reference to FIGS. 12A and 12B.

The pattern image 950 is a test image to generate the correction data 910 in the display unit 1000. That is, the pattern image 950 is an image for comparing the difference between the pattern image 950 displayed on the display unit 1000 and stored in the memory 900, and the captured pattern image 950. In addition, the pattern image 950 may include the location pattern image 960 and the pattern RGB image 980.

The location pattern image 960 may be allowed to calculate a deviation between the position pattern image 960 displayed on the display unit 1000 and the position pattern image 960 captured by the camera 200, and to recognize that a certain position in the stored location pattern image 960 is placed in which position of the position pattern image 960 captured by the camera 200, thereby adjusting an RGB value in an appropriate position when generating the correction data 910.

When the size and the capturing distance of the display apparatus 600 is constant when correcting the mura of the display apparatus 600, the position pattern image 960 may be not required since the correction data 910 is generated from the predetermined data. However, when the size or the capturing distance of the display apparatus 600 is not constant, the correction data 910 may be generated by matching a position pattern image 960 that is displayed after capturing the position pattern image 960, with the position pattern image 960 that is object to be captured.

The RGB pattern image 980 may be an image used to generate the correction data 910 to equalize an RGB value of pixels of the display unit 1000 as a reference RGB value by recognizing a difference between an RGB value of pixels of the display unit 1000.

Particularly, the RGB pattern image 980 is an image that displays a pattern image 950 having a predetermined RGB value. That is, as for the RGB pattern image 980, an R value, a G value and a B value may have a predetermined ratio and there may be at least one kind of the RGB pattern image 980. For example, the RGB pattern image 980 may be a gray image in which an R value, a G value and a B value have the same value in one RGB pattern image 980 but the R value, the G value and the B value are different value from another RGB pattern image 980.
In addition, the pattern RGB pattern image 980 may be a pattern image 950 in which one of an R value, a G value and a B value is different and the rest of values are fixed according to the RGB pattern image 980. That is, the RGB pattern image 980 may be a combination of a pattern image 950 in which a G value, and a B value, except for an R value are fixed and the R value is changed, a pattern image 950 in which an R value, and a B value, except for a G value are fixed and the G value is changed, and a pattern image 950 in which an R value, and a G value, except for a B value are fixed and the B value is changed.

In addition, the RGB image pattern 980 may be an image having a variety of bits. Particularly, the RGB image pattern 980 may be an 8bit-pattern image 950 having 256-level image. The RGB pattern image 980 may be plural and the RGB pattern image 980 may be 256 images or 768 images, but may have equal to or less than 256 images or 768 images. For example, as for the RGB pattern image 980, a gray image may be five of RGB pattern images 980 having 10 level (i.e., R value/G value/ B value is 10/10/10), 25 level (25/25/25), 40 level (40/40/40), 60 level (60/60/60), and 200 level (200/200/200).

Further, the pattern image 950 may be implemented such that the position pattern image 960 and the RGB pattern image 980 are simultaneously implemented at a single image. Particularly, the pattern image 950 may be synthesized such that a position pattern of the position pattern image is placed at a position in which the probability of occurrence of the mura is low, and the remaining part has the characteristics of the RGB image pattern 980.

The display unit 1000 may display the pattern image 950 stored in the memory 900 so that the camera 200 captures the displayed pattern image 950 to allow the display correction apparatus 100 to generate the correction data 910.

The display unit 1000 may include a flat display unit 1000, a curved display unit 1000 having a curvature, and a flexible display unit 1000 in which a curvature is adjustable.

An output resolution of the display unit 1000 may include High Definition (HD), Full HD, and Ultra HD. A diagonal length of a screen of the display unit 1000 may be less than 650 mm, 660 mm, 800 mm, 1,010 mm, 1,520 mm, 1,890 mm, or more than 2,000
A horizontal-vertical length of the screen of the display unit 1000 may include 643.4 mm x 396.5 mm, 934.0 mm x 548.6 mm, 1,670.2 mm x 962.7 mm or 2,004.3 mm x 1,635.9 mm. Alternatively, a horizontal-vertical ratio of the screen of the display unit 1000 may include 4:3, 16:9, 16:10, 21:9 or 21:10.

FIG. 2A is a view illustrating an appearance of the display correction system in accordance with one embodiment, FIG. 2B is a view illustrating an appearance of a display correction system in accordance with another embodiment, FIG. 2C is a view illustrating an appearance of a display correction system in accordance with alternate another embodiment.

As shown in FIGS. 2A to 2C, the display apparatus 600 may be provided and then the display correction apparatus 100 may be provided in front of the display unit 1000 of the display apparatus 600.

As for the display correction apparatus 100, the camera 200 attached to the tripod may be placed in a position from the display apparatus 600 by a predetermined distance. In addition, a single camera 200 may be provided, but alternatively, a plurality of cameras 200 may be provided to capture a different region of the display apparatus 600. For example, as for the curved display apparatus 600, a plurality of cameras 200 may be provided in a position that is the center of the curved surface. Alternatively, the camera 200 may be placed in various positions and a variety of number of the camera 200 may be used for generating the correction data 910 by capturing the displayed pattern image 950.

In addition, as for the display correction apparatus 100, a housing 150 for supporting and protecting the sampling unit 250, the image analyzer 300, the characteristic corrector 400 and the first communication unit 500 except for the camera 200 may be provided. In the housing 150, the sampling unit 250, the image analyzer 300, the characteristic corrector 400 and the first communication unit 500 except for the camera 200 may be placed.

According to one embodiment, the connection among the display apparatus 600, the housing 150 and the camera 200 may be configured such that the display apparatus 600 and the housing 150 are connected by a wired communication and the housing 150 and the camera 200 are connected by a wired communication.
According to the another embodiment, the connection among the display apparatus 600, the housing 150 and the camera 200 may be configured such that the display apparatus 600 and the housing 150 are connected by a wireless communication and the housing 150 and the camera 200 are connected by a wired communication.

According to the alternate another embodiment, the connection among the display apparatus 600, the housing 150 and the camera 200 may be configured such that the display apparatus 600 and the housing 150 are connected by a wired communication and the housing 150 and the camera 200 are connected by a wireless communication.

Hereinbefore the configuration of the display correction system according to one embodiment has been described.

Hereinafter a display correction method according to embodiments will be described.

Hereinafter a display correction method according to embodiment A will be described with reference to FIGS. 3 to 6.

FIG. 3 is a block diagram illustrating a configuration of a display correction system generating a correction data according to the embodiment A.

The display unit 600 may display the RGB image pattern 980. In other words, the display unit 600 may display a first RGB pattern image (980_1). The camera 200 may capture the first RGB pattern image (980_1) to convert the captured first RGB pattern image (980_1) into an image signal and then transmit the image signal to the image analyzer 300. The RGB pattern mapping unit 320 of the image analyzer 300 may map an RGB value of each pixel. The RGB pattern mapping unit 320 may transmit the mapped RGB value of each pixel to the characteristic corrector 400.

The RGB comparator 410 of the characteristic corrector 400 may compare the RGB value of each pixel with an RGB average value of all pixels, or compare the RGB value of each pixel with an RGB average value of a predetermined division region including the corresponding pixel. Further the RGB comparator 410 may compare the RGB value of each pixel with an RGB average value of a predetermined certain region.
Based on the RGB value compared by the RGB comparator 410, the correction data calculator 420 may generate the correction data 910 so that an RGB value displayed by each pixel displays a reference RGB value.

The correction data 910 may be data generated such that a correction value of each pixel of the display apparatus 600 is arranged in a matrix. As for the correction data 910, a first correction data (910_1) may be generated by the first RGB pattern image (980_1), a second correction data (910_2) may be generated by a second RGB pattern image (980_2), and an nth correction data (910_n) may be generated by an nth RGB pattern image (980_n).

That is, when the first correction data (910_1) is generated by the first RGB pattern image (980_1), the display apparatus 600 may generate the second correction data (910_2) by displaying the second RGB pattern image (980_2), and thus the display apparatus 600 may repeatedly generate a next turn of correction data 910 by displaying a next turn of RGB pattern image 980.

The embodiment A may include embodiment A1, embodiment A2, and embodiment A3. The embodiment A1 may be a case of comparing an RGB value of each pixel with an RGB average value of all pixels and setting a reference RGB value as the RGB average value of all pixels. The embodiment A2 may be a case of comparing an RGB value of each pixel with an RGB average value of a predetermined division region including a corresponding pixel and setting a reference RGB value as the RGB average value of a predetermined division region including the corresponding pixel. The embodiment A3 may be a case of comparing an RGB value of each pixel with an RGB average value of a predetermined certain region and setting a reference RGB value as the RGB average value of a predetermined certain region.

FIG. 4 is a flowchart illustrating a method for generating a correction data according to the embodiment A1.

The display apparatus may display the RGB pattern image. The camera may capture the displayed RGB pattern image (100) and then convert the captured RGB pattern image into an image signal. The image analyzer may calculate an RGB value of each pixel and an RGB average value of entire regions of the captured RGB
pattern image (110) and then compare the RGB value with the RGB average value by corresponding to each pixel.

The characteristic corrector may generate the correction data based on the RGB value of each pixel and the calculated RGB average value (120). That is, by setting the calculated RGB average value as a reference RGB value, the RGB value of each pixel may be set to the reference RGB value.

The characteristic corrector may determine whether a currently captured RGB pattern image is an nth RGB pattern image (130).

When the currently captured RGB pattern image is not an nth RGB pattern image, the controller of the display apparatus may load a next turn of RGB pattern image from the memory (140), and then display the next turn of RGB pattern image on the display unit. The display correction apparatus may sequentially perform a step of 100 to 300 again based on the displayed RGB pattern image.

When the currently captured RGB pattern image is the nth RGB pattern image, the first communication unit may transmit the calculated correction data to the second communication unit of the display apparatus (150), and the second communication unit may transmit the transmitted correction data to the memory to store the transmitted correction data in the memory (160).

At last, the display apparatus may display an image by transmitting a control signal to the display unit based on the correction data stored in the memory (170).

FIG. 5 is a flowchart illustrating a method for generating a correction data according to the embodiment A2.

The display apparatus may display the RGB pattern image. The camera may capture the displayed RGB pattern image (200) and then convert the captured RGB pattern image into an image signal. The image analyzer may calculate an RGB value of each pixel and an RGB average value of the predetermined division region of the captured RGB pattern image (210) and then compare the RGB value with the RGB average value by corresponding to each pixel.

Then, the characteristic corrector may generate the correction data based on the RGB value of each pixel and the calculated RGB average value of the predetermined division region (220). That is, by setting the calculated RGB average
value as a reference RGB value, the RGB value of each pixel may be set to the reference RGB value.

The characteristic corrector may determine whether a currently captured RGB pattern image is an \( n_{th} \) RGB pattern image (230).

When the currently captured RGB pattern image is not the \( n_{th} \) RGB pattern image, the sampling unit may reset the predetermined division region based on the RGB value (240). Particularly, the sampling unit may set pixels in the same group as a predetermined division region by grouping pixels having an RGB value in a predetermined range.

The controller of the display apparatus may load a next turn of RGB pattern image from the memory (250), and then display the next turn of RGB pattern image on the display unit. The display correction apparatus may sequentially perform a step of 200 to 230 again based on the displayed RGB pattern image.

When the currently captured RGB pattern image is the \( n_{th} \) RGB pattern image, the first communication unit may transmit the calculated correction data to the second communication unit of the display apparatus (260), and the second communication unit may transmit the transmitted correction data to the memory to store the delivered correction data in the memory (270).

At last, the display apparatus may display an image by transmitting a control signal to the display unit based on the correction data stored in the memory (280).

FIG. 6 is a view illustrating a concept of generating a correction data according to the embodiment A3.

The display apparatus may display the RGB pattern image. The camera may capture the displayed RGB pattern image and then convert the captured RGB pattern image into an image signal. The image analyzer may map an RGB value of each pixel of entire region (TI) of the captured RGB pattern image.

Further, the image analyzer may calculate an RGB average value of the predetermined certain region (CI) and the characteristic corrector may set the RGB average value of the predetermined certain region (CI) as a reference RGB average value and then generate the correction data so that the RGB value displayed on each pixel displays the reference RGB value.
Hereinafter a display correction method according to embodiment B will be described with reference to FIGS. 7 to 11.

FIG. 7 is a block diagram illustrating a display correction system 1 generating a correction data 910 according to the embodiment B.

The display unit 600 may display the RGB image pattern 980. Particularly, the display unit 600 may display a first RGB pattern image (980_1). The camera 200 may capture the first RGB pattern image (980_1) to convert the captured first RGB pattern image (980_1) into an image signal and then transmit the image signal to the sampling unit 250.

The sampling unit 250 may sample an RGB value of the first region included in a plurality of predetermined division regions, and then transmit the sampled RGB value of the first region to the image analyzer 300. The RGB pattern mapping unit 320 of the image analyzer 300 may map the RGB value of the first region.

The RGB estimator 330 may estimate an RGB value of the second region included in the plurality of predetermined division regions. Particularly, the RGB estimator 330 may estimate the RGB value of the second region by using the linear interpolation method based on the RGB value of the first region of one predetermined division region including the second region to be estimated, and an RGB value of a first region of another predetermined division region adjacent the one predetermined division region. The image analyzer 300 may transmit the mapped RGB value of each pixel to the characteristic corrector 400.

The RGB comparator 410 of the characteristic corrector 400 may compare the RGB value of each pixel with the RGB average value of the predetermined division region including the corresponding pixel, or compare the RGB value of each pixel with the RGB average value of the first region included in the predetermined division region including the corresponding pixel. In addition, the RGB comparator 410 may compare the RGB value of each pixel with the RGB average value of the predetermined certain region.

The correction data calculator 420 may generate the correction data 910 based on the RGB value compared by the RGB pattern comparator, so that the RGB value displayed by each pixel displays the reference RGB value.
The correction data 910 may be data generated such that a correction value of each pixel of the display apparatus 600 is arranged in a matrix. As for the correction data 910, a first correction data (910_1) may be generated by a first RGB pattern image (980_1), a second correction data (910_2) may be generated by a second RGB pattern image (980_2), and an nth correction data (910_n) may be generated by an nth RGB pattern image (980_n).

That is, when the first correction data (910_1) is generated by the first RGB pattern image (980_1), the display apparatus 600 may generate the second correction data (910_2) by displaying the second RGB pattern image (980_2), and thus the display apparatus 600 may repeatedly generate a next turn of correction data 910 by displaying a next turn of RGB pattern image 980.

The embodiment B may include embodiment B1, embodiment B2, embodiment B3, and embodiment B4. The embodiment B1 may be a case of comparing the RGB value of each pixel with the RGB average value of the first region of the predetermined division region including the corresponding pixel and setting a reference RGB value as the RGB average value of the first region of the predetermined division region including the corresponding pixel. The embodiment B2 may be a case in which a center portion of the predetermined division region is set to the first region. The embodiment B3 may be a case in which an upper left portion of the predetermined division region is set to the first region. The embodiment B4 may be a case in which a certain RGB value is expanded to one side when another predetermined division region is not present in one side of the predetermined division region.

FIG. 8 is a flowchart illustrating a method for generating a correction data according to the embodiment B1.

The display apparatus may display the RGB pattern image. The camera may capture the displayed RGB pattern image (300) and then convert the captured RGB pattern image into an image signal. The sampling unit may sample the image signal of the first region.

The image analyzer may calculate an RGB value of the first regions included in the predetermined division regions among the captured RGB pattern images, and an RGB average of the first regions (310).
The image analyzer may estimate an RGB value of the second region of the predetermined division regions based on the RGB value of the first regions adjacent to the second region to be estimated (320). Particularly, the RGB value of the second region between the RGB values of the first region adjacent to the second region may be estimated by using the linear interpolation method.

The characteristic corrector may calculate the correction data based on the RGB value of each pixel and the calculated RGB average value of the first region (330). That is, by setting the calculated RGB average value as the reference RGB value, the RGB value of each pixel may be set to the reference RGB value.

The characteristic corrector may determine whether a currently captured RGB pattern image is an \( n \)th RGB pattern image (340).

When the currently captured RGB pattern image is not the \( n \)th RGB pattern image, the sampling unit may re-set a predetermined division region based on the RGB value (350). Particularly, the sampling unit may re-set pixels in the same group as a predetermined division region by grouping pixels having an RGB value in a predetermined range.

The controller of the display apparatus may load a next turn of RGB pattern image from the memory (360), and then display the next turn of RGB pattern image on the display unit. The display correction apparatus may sequentially perform a step of 300 to 340 again based on the displayed RGB pattern image.

When the currently captured RGB pattern image is the \( n \)th RGB pattern image, the first communication unit may transmit the calculated correction data to the second communication unit of the display apparatus (370), and the second communication unit may transmit the transmitted correction data to the memory to store the transmitted correction data in the memory (380).

At last, the display apparatus may display an image by transmitting a control signal to the display unit based on the correction data stored in the memory (390).

FIG. 9 is a view illustrating a concept of generating a correction data according to the embodiment B2.

As illustrated in FIG. 9, the predetermined division region may be a group of nine pixels. A center portion of the predetermined division region may be set as the
first region (A1) and a portion of the predetermined division region except for the first region (A1) may be set as the second region (A2).

Further, the captured RGB image pattern may be an example having 25 predetermined division regions in 225 pixels (15 x 15 pixels), but the number of pixels and the number of the predetermined division region are not limited thereto. For calculating the correction data to correct the display apparatus based on the RGB pattern image, a variety of numbers of pixels and a variety of number of predetermined division regions may be used.

Particularly, the sampling unit may calculate an RGB value of a first region (A1) of 13th predetermined division region (DL_13), and estimate an RGB value of a second region (A2) included in the 13th predetermined division region by using an RGB value of a first region (A1) of each of seventh predetermined division region (DL_7), eighth predetermined division region (DL_8), ninth predetermined division region (DL_9), 12th predetermined division region (DL_12), 14th predetermined division region (DL_14), 17th predetermined division region (DL_17), 18th predetermined division region (DL_18) and 19th predetermined division region (DL_19) which are adjacent to the 13th predetermined division region (DL_13) and by using the linear interpolation method.

For example, when an RGB value of P78 of the 13th predetermined division region (DL_13) and P68 of the eighth predetermined division region (DL_8) are estimated, the RGB value of P78 and the RGB value of P68 may be estimated as an RGB value having a linear difference between an RGB value of P58 and an RGB value of P88.

FIG. 10 is a view illustrating a concept of generating a correction data according to the embodiment B3.

As illustrated in FIG. 10, the predetermined division region may be a group of nine pixels. An upper left portion of the predetermined division region may be set as the first region (A1) and a portion of the predetermined division region except for the first region (A1) may be set as the second region (A2).

Further, the captured RGB image pattern may be an example having 25 predetermined division regions in 225 pixels (15 x 15 pixels), but the number of pixels and the number of the predetermined division region are not limited thereto.
For calculating the correction data to correct the display apparatus based on the RGB pattern image, a variety of numbers of pixels and a variety of number of predetermined division regions may be used.

Particularly, the sampling unit may calculate an RGB value of a first region (A1) of 13th predetermined division region (DL_13), and estimate an RGB value of a second region (A2) included in the 13th predetermined division region by using an RGB value of a first region (A1) of each of seventh predetermined division region (DL_7), eighth predetermined division region (DL_8), ninth predetermined division region (DL_9), 12th predetermined division region (DL_12), 14th predetermined division region (DL_14), 17th predetermined division region (DL_17), 18th predetermined division region (DL_18), and 19th predetermined division region (DL_19) which are adjacent to the 13th predetermined division region (DL_13) and by using the linear interpolation method.

For example, when an RGB value of P67 of the 13th predetermined division region (DL_13) and P57 of the eighth predetermined division region (DL_8) are estimated, the RGB value of P 67 and the RGB value of P57 may be estimated as an RGB value having a linear difference between an RGB value of P47 and an RGB value of P77.

FIG. 11 is a view illustrating a concept of generating a correction data according to the embodiment B4.

As illustrated in FIG. 11, a side of the captured RGB pattern image illustrates that the adjacent predetermined division is not sufficient to estimate an RGB value of a second region by using the liner interpolation method. Therefore, an arbitrary RGB value may be required on one side where a predetermined division region is not present.

In this case, the RGB estimator may expand the predetermined division region in the lower side to the lower side to generate a first virtual region (VI_1) and estimate an RGB value of the second region based on an RGB value of the first virtual region (VI_1).

In addition, the RGB estimator may expand the predetermined division region in the right side to the right side to generate a second virtual region (VI_2) and
estimate an RGB value of the second region based on an RGB value of the second virtual region (VI_2).

In addition, the RGB estimator may diagonally expand an RGB average value of the first region included in a predetermined division region in the lower right side to the lower right side so as to generate a third virtual region (VI_3) and estimate an RGB value of the second region based on an RGB value of the third virtual region (VI_3).

Hereinbefore the RGB value of each pixel and the RGB value corresponding thereof has been described according to one embodiment.

Hereinafter a method for calculating correction data by using a matrix will be described according to one embodiment.

Hereinafter embodiments of display correction method will be described with reference to FIGS. 12A and 12B.

The characteristic corrector 400 may generate a correction value of each pixel by using the RGB value analyzed by the image analyzer 300, a captured position deviation of the corresponding pixel, and the capture environment of the camera 200 and generate the correction data 910 by using the correction value.

Particularly, the characteristic corrector 400 may calculate an absolute light intensity by considering the capture environment of the camera 200, and then apply the absolute light intensity to an RGB value. The absolute light intensity will be described through equation 1.

[Equation 1]

\[
\text{absolute light intensity} = \frac{(\text{exposure time}) \times (\text{Brightness information of color})}{(\text{sensitivity}) \times (\text{Aperture value})^2} \times \text{(correction coefficient)}
\]

Equation 1 is an equation for calculating the absolute intensity. Equation 1 may be proportional to the exposure time and inversely proportional to the sensitivity and the square of the aperture value.

The characteristic corrector 400 may calculate a correction value of the corresponding pixel based on the RGB value of the corresponding pixel and the
RGB average value of the entire region of the display unit 1000. A description thereof will be described through equation 2.

[Equation 2]
\[
\text{correction value} = ((\text{RGB value of displayed RGB pattern image})
- (\text{RGB value of corresponding pixel})
/ (\text{RGB average value of pixels of entire region})) \times (\text{correction coefficient})
\]

Equation 2 is an equation for calculating a correction value based on the RGB value of the corresponding pixel and the RGB average value of entire region of the display unit 1000. According to equation 2, the correction value is obtained by subtracting a value, which is obtained by dividing the RGB value of the corresponding pixel by the RGB average value of pixels of entire regions, from an initial RGB value of the displayed RGB pattern image 980, and then multiplying the correction coefficient to the value.

In addition, the characteristic corrector 400 may calculate a correction value of the corresponding pixel based on the RGB value of the corresponding pixel and the RGB average value of the certain region of the display unit 1000. A description thereof will be described through equation 3.

[Equation 3]
\[
\text{correction value} = ((\text{RGB value of displayed RGB pattern image}) - 
(\text{RGB value of corresponding pixel})/(\text{RGB average value of pixels of certain region})) \times 
(\text{correction coefficient})
\]

Equation 3 is an equation for calculating a correction value based on the RGB value of the corresponding pixel and the RGB average value of the certain region of the display unit 1000. According to equation 3, the correction value is obtained by subtracting a value, which is obtained by dividing the RGB value of the corresponding pixel by the RGB average value of pixels of the certain region, from an initial RGB value of the displayed RGB pattern image 980, and then multiplying the correction coefficient to the value.
FIG. 12A is a view illustrating a process of generating the correction data 910 through a matrix according to one embodiment.

As illustrated in FIG. 12A, it may be assumed that in an 8bit-RGB pattern image 980, the RGB pattern image 980 having five levels is displayed on the display apparatus 600, and the display unit 1000 has 25 pixels (5x5 pixels).

As illustrated in FIG. 12A, an RGB value captured by the camera 200 may be that P11 is 125, P12 is 50, P13 is 0(zero), P14 is 25, P15 is 75, P21 is 200, P22 is 100, P23 75, P24 is 50, P25 is 0, P31 is 250, P32 is 175, P33 is 125, P34 is 100, P35 is 125, P41 is 225, P42 is 175, P43 is 175, P44 is 250, P45 is 175, P51 is 225, P52 is 175, P53 is 275, P54 is 375 and P55 is 250. In addition, RGB values are arranged in a matrix type as a first matrix (PM_1).

The image analyzer 300 may arrange a value obtained by dividing an RGB value of the corresponding pixel by the reference RGB value, in a matrix by setting an RGB average value of P33 in the center portion thereof, as the reference RGB value. For example, the value may be arranged as a second matrix (PM_2) in which P11 is 1, P12 is 0.4, P13 is 0 (zero), P14 is 0.2, P15 is 0.6, P21 is 1.6, P22 is 0.8, P23 is 0.6, P24 is 0.4, P25 is 0(zero), P31 is 2, P32 is 1.4, P33 is 1, P34 is 0.8, P35 is 1, P41 is 1.8, P42 is 1.4, P43 is 1.4, P44 is 2, P45 is 1.4, P51 is 1.8, P52 is 1.4, P53 is 2.2, P54 is 3, and P55 is 2.

The image analyzer 300 may arrange an RGB level value of each pixel as in a third matrix (PM_3) by multiplying the reference RGB value of the displayed RGB pattern image 980 to the second matrix (PM_2). For example, the value may be arranged as the third matrix (PM_3) in which P11 is 5, P12 is 2, P13 is 0 (zero), P14 is 1, P15 is 3, P21 is 8, P22 is 4, P23 is 3, the P24 is 2, P25 is 0, P31 is 10, P32 7, P33 is 5, P34 is 4, P35 is 5, P41 is 9, P42 is 7, P43 is 7, P44 is 10, P45 is 7, P51 is 9, P52 is 7, P53 is 11, P54 is 15, and P55 is 10.

Calculating an RGB level value of each pixel by the image analyzer 300 will be expressed by equation 4.

30 [Equation 4]
According to equation 4, the image analyzer 300 may calculate the RGB level value of the corresponding pixel by multiplying a value obtained by dividing the RGB value of the corresponding pixel by the RGB average value of the certain region, to the reference level of the displayed RGB pattern image 980.

The characteristic corrector 400 may calculate a correction value of the corresponding pixel by subtracting the RGB level value of the corresponding pixel from the reference level of the displayed RGB pattern image 980, based on the RGB level value of the corresponding pixel. A description thereof will be described through equation 5.

**[Equation 5]**

\[
\text{correction value of corresponding pixel} = (\text{reference level of displayed RGB pattern image}) - (\text{RGB level value of corresponding pixel})
\]

According to equation 5, the characteristic corrector 400 may calculate a correction value by subtracting the RGB level value of the corresponding pixel from the reference level of the displayed RGB image pattern 980.

However, when the correction value is negative number and the absolute value of the correction value is larger than a reference level, the characteristic corrector 400 may set the correction value as a negative number of absolute value of the reference level. For example, when the reference level is 5 although an actual correction value of P53 is -6, the characteristic corrector 400 may set a correction value to -5.

In addition, the characteristic corrector 400 may allow a value by adding the reference value to the correction value to not exceed the maximum level of the RGB image pattern 980. For example, when the reference level is 250 and the correction value is 6, the correction value may be set to 5 in an environment of the 8 bit-RGB pattern image 980.
As mentioned above, the characteristic corrector 400 may arrange a calculated correction value as a fourth matrix (PM_4) by applying the third matrix (PM_3). For example, the value may be arranged as the fourth matrix (PM_4) in which P11 is 0 (zero), P12 is +3, P13 is +5, P14 is +4, P15 is +2, P21 is -3, P22 is +1, P23 is +2, P24 is +3, P25 is 5, P31 is -5, P32 is -2, P33 is 0, P34 is +1 is, P35 is 0 (zero), P41 is -4, P42 is -2, P43 is -2, P44 is -5, P45 is -2, P51 is -4, P52 is -2, P53 is -5, P54 is -5 and P55 is -5.

FIG. 12B is a view illustrating a process of generating the correction data 910 through a matrix according to another embodiment.

As illustrated in FIG. 12B, it may be assumed that in the 8bit -RGB pattern image 980, the RGB pattern image 980 having five levels is displayed on the display apparatus 600, and the display unit 1000 has 25 pixels (5x5 pixels).

As illustrated in FIG. 12B, an RGB value captured by the camera 200 may be that P11 is 125, P12 is 50, P13 is 0 (zero), P14 is 25, P15 is 75, P21 is 200, P22 is 100, P23 75, P24 is 50, P25 is 0, P31 is 250, P32 is 175, P33 is 125, P34 is 100, P35 is 125, P41 is 225, P42 is 175, P43 is 175, P44 is 250, P45 is 175, P51 is 225, P52 is 175, P53 is 275, the P54 is 375 and P55 is 250. The RGB values may be arranged in a matrix, as a first matrix (PM_1).

The image analyzer 300 may arrange a value obtained by dividing an RGB value of the corresponding pixel by the reference RGB value, in a matrix by setting an RGB average value of P33 in the center portion thereof, as the reference RGB value. For example, the value may be arranged as a second matrix (PM_2) in which P11 is 1, P12 is 0.4, P13 is 0 (zero), P14 is 0.2, P15 is 0.6, P21 is 1.6, P22 is 0.8, P23 is 0.6, P24 is 0.4, P25 is 0 (zero), P31 is 2, P32 is 1.4, P33 is 1, P34 is 0.8, P35 is 1, P41 is 1.8, P42 is 1.4, P43 is 1.4, P44 is 2, P45 is 1.4, P51 is 1.8, P52 is 1.4, P53 is 2.2, P54 is 3, and P55 is 2.

The image analyzer 300 may arrange an RGB level value of each pixel as in a third matrix (PM_3) by multiplying the reference RGB value of the displayed RGB pattern image 980 to the second matrix (PM_2). For example, the value may be arranged as the third matrix (PM_3) in which P11 is 5, P12 is 2, P13 is 0 (zero), P14 is 1, P15 is 3, P21 is 8, P22 is 4, P23 is 3, the P24 is 2, P25 is 0 (zero), P31 is 10,
P32 7, P33 is 5, P34 is 4, P35 is 5, P41 is 9, P42 is 7, P43 is 7, P44 is 10, P45 is 7, P51 is 9, P52 is 7, P53 is 11, P54 is 15, and P55 is 10.

Calculating an RGB level value of each pixel by the image analyzer 300 will be expressed by equation 6.

[Equation 6]

\[
\text{RGB level value of corresponding pixel} = \left( \frac{\text{RGB value of corresponding pixel}}{\text{RGB average value of certain region}} \right) \times \text{(reference level of displayed RGB pattern image)}
\]

According to equation 6, the image analyzer 300 may calculate the RGB level value of the corresponding pixel by multiplying a value, which is obtained by dividing the RGB value of the corresponding pixel by the RGB average value of the certain region, to the reference level of the displayed RGB pattern image 980.

The characteristic corrector 400 may calculate a correction value of the corresponding pixel by subtracting the RGB level value of the corresponding pixel from the reference level of the displayed RGB pattern image 980, based on the RGB level value of the corresponding pixel. A description thereof will be described through equation 7.

[Equation 7]

\[
\text{correction value of corresponding pixel} = \left( \frac{(\text{reference level of displayed RGB pattern image})^2}{\text{(RGB level value of corresponding pixel)}} \right) - \text{(reference level of displayed pattern image)}
\]

According to equation 7, the characteristic corrector 400 may calculate a correction value by subtracting a value, which is obtained by dividing the reference level of the square of displayed pattern image by the RGB level value of the corresponding pixel, from the reference level of the displayed RGB pattern image 980.

However, when the RGB level value of the corresponding pixel is 0 (zero), the characteristic corrector 400 may perform a correction by setting an arbitrary RGB level value.
As mentioned above, the characteristic corrector 400 may arrange a calculated correction value as a fourth matrix (PM_4) by applying the third matrix (PM_3). For example, the value may be arranged as the fourth matrix (PM_4) in which, P11 is 0 (zero), P12 is +7.5, P13 is 0 (zero), P14 is +20.0, P15 is +3.3, P21 is -1.9, P22 is +1.3, P23 is +3.3, P24 is +7.5, P25 is 0 (zero), P31 is -2.5, P32 is -1.4, P33 is 0 (zero), P34 is +1.3, P35 is 0 (zero), P41 is -2.2, P42 is -1.4, P43 is -1.4, P44 is -2.5, P45 is -1.4, P51 is -2.2, P52 is -1.4, P53 is -2.7, P54 is -3.3, and P55 is -2.5.

Hereinbefore the correction method of the display correction system, in which a relation between the captured pattern image and the displayed pattern image is predetermined, has been described according to one embodiment.

Hereinafter a correction method of a display correction system after setting a relation between the captured pattern image and the displayed pattern image, by using the position pattern image, will be described according to one embodiment.

FIG. 13 is a flowchart illustrating a method for generating a correction data according to embodiment C.

The display apparatus may display the position pattern image. The camera may capture the displayed position pattern image (400) and then convert the captured position pattern image into an image signal. The image analyzer may calculate a deviation by comparing the displayed position pattern image with the captured position pattern image based on the feature point of the position pattern image, thereby recognizing a position in the image where a pixel of the display unit is captured (410).

The display apparatus may display the RGB pattern image. The camera may capture the displayed RGB pattern image (420) and then convert the captured RGB pattern image into an image signal. The image analyzer may calculate an RGB value of each pixel and an RGB average value of entire region of the captured RGB pattern image (430) and then compare the two values by corresponding to each pixel. The characteristic corrector may generate the correction data based on the RGB value of each pixel and the calculated RGB average value. That is, by setting the calculated RGB average value as the reference RGB value, the RGB value of each pixel may be set to the reference RGB value.
The characteristic corrector may determine whether a currently captured RGB pattern image is an \( n_{th} \) RGB pattern image (440).

When the currently captured RGB pattern image is not the \( n_{th} \) RGB pattern image, the controller of the display apparatus may load a next turn of RGB pattern image from the memory (450), and then display the next turn of RGB pattern image. The display correction apparatus may sequentially perform a step of 420 to 440 again based on the displayed RGB pattern image.

When the currently captured RGB pattern image is the \( n_{th} \) RGB pattern image, the first communication unit may transmit the calculated correction data to the second communication unit of the display apparatus (460), and the second communication unit may transmit the transmitted correction data to the memory to store the transmitted correction data in the memory (470).

At last, the display apparatus may display an image by transmitting a control signal to the display unit based on the correction data stored in the memory (480).

FIGS. 14A to 14G illustrate embodiments of a position pattern image.

A position pattern image (PI) is a pattern image used for recognizing a deviation between a position of pixel displayed in the display and a position of pixel displayed in the captured image, comparing an RGB value thereof, and calculating a correction data.

As illustrated in FIGS. 14A to 14G, the position pattern image (PI) is an image in which a feature point is present, particularly, the feature point in the form of point, line or surface may be regularly or irregularly present in the position pattern image (PI).

Hereinbefore a method for generation the correction data to correct the display apparatus has been described according to one embodiment.

Hereinafter an RGB value of the display apparatus in which a correction data that is calculated according to one embodiment will be described.

Hereinafter a variation of the RGB value between before and after correcting the display apparatus will be described with reference to FIGS. 15A to 16B.

FIG. 15A is a graph illustrating a distribution of an RGB value of the display apparatus before correction in accordance with one embodiment, and FIG. 15B is a
graph illustrating a distribution of an RGB value of the display apparatus after correction in accordance with one embodiment.

FIGS. 15A and 15B illustrate a graph of the RGB value in two different horizontal axes in which an RGB pattern gray image having 65 levels among 8bit-RGB pattern images on the display unit is displayed.

As illustrated in FIG. 15A, an RGB value of an RGB pattern image that is captured before correction may have a shape in which an RGB value of the center portion is high and an RGB value of opposite side portion is low. That is, the RGB value does not have a value in which a vertical and horizontal RGB characteristic is uniform, according to a position of the horizontal axis.

However, as illustrated in FIG. 15B, an RGB value of an RGB pattern image that is captured after correction may have a value in which a vertical and horizontal RGB characteristic is uniform. Further, gamma characteristic may have a similar feature according to the position.

FIG. 16A is a graph illustrating a distribution of an RGB value of the display apparatus before correction in accordance with another embodiment, and FIG. 16B is a graph illustrating a distribution of an RGB value of the display apparatus after correction in accordance with another embodiment.

FIGS. 16A and 16B illustrate a graph of the RGB value in four different vertical axes in which an RGB pattern gray image having 65 levels among 8bit-RGB pattern images on the display unit is displayed.

As illustrated in FIG. 16A, an RGB value of an RGB pattern image that is captured before correction may have a shape in which an RGB value of the center portion is high and an RGB value of opposite side portion is low. That is, the RGB value does not have a value in which a vertical and horizontal RGB characteristic is uniform, according to a position of the vertical axis.

However, as illustrated in FIG. 16B, an RGB value of an RGB pattern image that is captured after correction may have a value in which a vertical and horizontal RGB characteristic is uniform. Further, gamma characteristic may have a similar feature according to the position.

Hereinafter a display correction system according to another embodiment will be described with reference to FIG. 17.
FIG. 17 is a perspective view illustrating a display correction system generating a correction data in a display correction apparatus.

A display correction system 1 may include a camera 200, a communication assembly 160, an input 750, and a display apparatus 600.

The camera 200 may be a component configured to capture a pattern image 950 displayed on the display and convert the captured image into an image signal, wherein the camera 200 may be identical to or different from the camera 200 illustrated in FIGS. 1 to 2C.

The communication assembly 160 may send and receive data to and from the camera 200 to connect the camera 200 to the display apparatus 600.

Particularly, the communication assembly 160 may include a first communication module 510 and a first communication port 520 which is similar with the first communication unit 500, and communicate with the camera 200 and the display apparatus 600 via a wired and/or a wireless communication. For example, the communication assembly 160 may receive the pattern image 950, which is captured by the camera 200, in the form of image signal and then provide the image signal to the display apparatus 600 to allow the correction data to be generated. Further, the communication assembly 160 may transmit a control signal to the camera 200 so that the camera 200 captures the displayed pattern image 950 at a point of time to display the pattern image 950 displayed on the display. In addition, the communication assembly 160 may receive an exposure time, a sensitivity (ISO), and an aperture value (F#) of the camera 200 when the pattern image 950 is captured, and then use the exposure time, the sensitivity (ISO), and the aperture value (F#) to generate the correction data when generating the correction data 910.

The communication method and the type of the communication assembly 160 may be identical to or different from the first communication unit 500 illustrated in FIG. 1.

The input 750 may control the display apparatus 600 by converting a command from a user into an input signal. Particularly, as illustrated in FIG. 17, the input 750 may be a remote control device capable of remotely controlling. A user may recognize a correction notification image displayed on the display apparatus
600 and determine whether to generate the correction data 910 to transmit the display apparatus 600 via the input 750.

The display apparatus 600 may display an image and receive an image obtained by capturing the displayed image to generate the correction data 910.

Particularly, the display apparatus 600 may include a memory 900, a display unit 1000, and a controller 800.

The memory 900 and the display unit 1000 illustrated in FIG. 17 may be identical to or different from the memory 900 and the display unit 1000 illustrated in FIG. 1.

The controller 800 may receive the pattern image 950 captured by the camera 200 and map an RGB value of each pixel. The controller 800 may generate the correction data 910 to equalize the RGB value of each pixel to a reference RGB value based on the mapped RGB value and then apply the correction data 910 to the display unit 1000.

The controller 800 of FIG. 17 may include a display controller 810 and a main controller 820 as the same as illustrated in FIG. 1. Further, the controller 800 of FIG. 17 may include a sampling unit 250, an image analyzer 300 and a characteristic corrector 400 as the same as illustrated in FIG. 1.

By using the display apparatus 600 capable of generating the correction data 910 by communication with the camera 200, a user may detect the deviation of the image quality caused by the accumulated use after shipment, and correct the detected the deviation.

Particularly, a difference in the RGB value displayed on the display apparatus 600 may occur due to the aging of the display apparatus 600 caused by the accumulated use after shipment, and the shock caused by the movement of the display apparatus 600. In order to correct the difference of the RGB value, the difference of the RGB value may be detected by connecting the communication assembly 160 connected to the display apparatus 600 to the camera 200. In this case, when the controller 800 of the display apparatus 600 determines that the detected difference in the RGB value is equal to or more than a predetermined value indicating the need of correction, the controller 800 may display the correction notification image (AI) on the display apparatus 600, as illustrated in FIG. 17.
Therefore, a user may recognize that the deviation of the RGB value displayed on the display apparatus 600 is present and thus the correction is required. As needed, the user may generate the correction data 910 by displaying the pattern image 950 to equalize the deviation of the RGB value of the display apparatus 600.

Although a few embodiments of the present disclosure have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the disclosure, the scope of which is defined in the claims and their equivalents.
【CLAIMS】

【Claim 1】 A display correction apparatus comprising:

a camera configured to capture a pattern image displayed on a display apparatus;

an image analyzer configured to calculate an RGB value of the captured pattern image; and

a characteristic corrector configured to correct the display apparatus based on the calculated RGB average value and RGB value of each pixel so that each pixel displays a calculated average value.

【Claim 2】 The display correction apparatus of claim 1 wherein

the characteristic corrector corrects the display apparatus based on an RGB average value of a predetermined certain region and the RGB value of each pixel.

【Claim 3】 The display correction apparatus of claim 1 wherein

the characteristic corrector corrects the display apparatus based on an RGB average value of a plurality of predetermined division regions and the RGB value of each pixel.

【Claim 4】 The display correction apparatus of claim 1 wherein

the image analyzer calculates an RGB value of a first region among the plurality of predetermined division regions, and estimates an RGB value of a second region in the predetermined division region based on the calculated RGB value.

【Claim 5】 The display correction apparatus of claim 4 wherein

the image analyzer estimates an RGB value of a first region included in another predetermined division region adjacent to one predetermined division region including the second region to be estimated, and an RGB value of a first region included in the one predetermined division region, by using the linear interpolation method.
【Claim 6】 The display correction apparatus of claim 1 wherein
the camera captures the pattern image without focusing on the pattern image.

【Claim 7】 A display apparatus comprising:
5 a display unit configured to display a pattern image; and
a memory configured to store the displayed pattern image and a correction
data allowing pixels of the display unit to display a uniform RGB value.

【Claim 8】 The display apparatus of claim 7 wherein
10 the pattern image comprises a position pattern image used for matching a
position of an image displayed on the display unit with a position of an image
captured by a camera, and an RGB pattern image used for generating a correction
data allowing pixels of the display unit to display a uniform RGB value.

【Claim 9】 The display apparatus of claim 7 further comprising:
15 a communication unit configured to receive the correction data calculated by
an external display correction apparatus, via at least one of wired communication
and wireless communication.

【Claim 10】 The display apparatus of claim 7 wherein
20 the correction data comprises a correction value of a predetermined certain
region and a deviation of another region.

【Claim 11】 A display correction system comprising:
25 a display apparatus configured to display a pattern image; and
a display correction apparatus comprising a camera capturing the displayed
pattern image, an image analyzer calculating an RGB value of the captured pattern
image, and a characteristic corrector generating a correction data allowing each pixel
to display a calculated average value based on the calculated RGB average value
30 and the RGB value of each pixel.
[Claim 12] The display correction system of claim 11 wherein
the characteristic corrector generates a correction data based on the RGB
average value of a predetermined certain region and the RGB value of each pixel.

[Claim 13] The display correction system of claim 11 wherein
the characteristic corrector generates a correction data based on the RGB
average value of a plurality of predetermined division regions and the RGB value of
each pixel.

[Claim 14] The display correction system of claim 11 wherein
the image analyzer calculates an RGB value of a first region among a plurality
of predetermined division regions, and estimates an RGB value of a second region in
the predetermined division region based on the calculated RGB value.

[Claim 15] The display correction system of claim 14 wherein
the image analyzer estimates an RGB value of the second region based on
an RGB value of a first region included in another predetermined division region
adjacent to one predetermined division region including the second region to be estimated, and an RGB value of a first region included in the one predetermined
division region, by using the linear interpolation method.

[Claim 16] The display correction system of claim 15 wherein
when the another predetermined division region is not present on one side of
the one predetermined division region, the image analyzer estimates an RGB value
of the second region by expanding the one predetermined division region to one
side.

[Claim 17] The display correction system of claim 15 wherein
when the another predetermined division region is not present on one side of
the one predetermined division region, the image analyzer estimates an RGB value
of the second region by expanding an RGB value of the first region included in the
one predetermined division region, to one side.

【Claim 18】The display correction system of claim 17 wherein
the RGB value expanded to the one side is an RGB average value of the first
region included in the one predetermined division region.

【Claim 19】The display correction system of claim 13 wherein
the predetermined division region is re-set by grouping pixels according to a
pre-calculated RGB value within a predetermined range.

【Claim 20】The display correction system of claim 11 wherein
the pattern image comprises a position pattern image used for matching a
position of an image displayed on the display apparatus with a position of an image
captured by a camera and an RGB pattern image used for generating a correction
data allowing pixels of the display apparatus to display a uniform RGB value.

【Claim 21】The display correction system of claim 20 wherein
the RGB pattern image represents a plurality of RGB pattern images in which
an R value, a G value and a B value have a different value with a predetermined
ratio.

【Claim 22】The display correction system of claim 21 wherein
the plurality of RGB pattern images represents that an R value, a G value and
a B value are the same in one RGB pattern image but an R value, a G value and a B
value have a different value in another RGB pattern image.

【Claim 23】The display correction system of claim 21 wherein
the plurality of RGB pattern images comprises an RGB pattern image in which
any one of an R value, a G value and a B value is different and the rest thereof are
the same.
【Claim 24】The display correction system of claim 21 wherein
the correction data is calculated by corresponding to the plurality of RGB
pattern images

【Claim 25】The display correction system of claim 11 wherein
the camera captures the pattern image without focusing on the pattern image.

【Claim 26】The display correction system of claim 11 wherein
the correction data comprises a correction value of a predetermined certain
region and a deviation of another region.

【Claim 27】The display correction system of claim 11 wherein
the display apparatus further comprises a communication unit configured to
receive the correction data calculated by the characteristic corrector, via at least one
of wired communication and wireless communication.

【Claim 28】A display correction method comprising:

- displaying a pattern image;
- calculating an RGB value of the captured pattern image by capturing the
displayed pattern image; and
- correcting to allow each pixel to display a calculated average value based on
the calculated RGB average value and RGB value of each pixel.

【Claim 29】The display correction method of claim 28 wherein
the correction is performed based on the RGB average value of a
predetermined certain region and the RGB value of each pixel.

【Claim 30】The display correction method of claim 28 wherein
the correction is performed based on the RGB average value of a plurality of
predetermined division regions and the RGB value of each pixel.
【Claim 31】The display correction method of claim 28 wherein
the calculation of an RGB value calculates an RGB value of a first region
among the plurality of predetermined division regions, and estimates an RGB value
of a second region in the predetermined division region based on the calculated
RGB value.

【Claim 32】The display correction method of claim 31 wherein
the RGB value of the second region is estimated based on an RGB value of a
first region included in another predetermined division region adjacent to one
predetermined division region including the second region to be estimated, and an
RGB value of a first region included in the one predetermined division region, by
using the linear interpolation method.

【Claim 33】The display correction method of claim 30 wherein
the predetermined division region is re-set by grouping pixels according to a
pre-calculated RGB value within a predetermined range.

【Claim 34】The display correction method of claim 28 wherein
the pattern image comprises a position pattern image used for matching a
position of the displayed image with a position of the captured image and an RGB
pattern image used for correcting to allow each pixel of the display apparatus to
display a uniform RGB value.
# INTERNATIONAL SEARCH REPORT

**International application No.**

PCT/KR2015/004546

## A. CLASSIFICATION OF SUBJECT MATTER

**H04N 9/69(2006.01), H04N 9/64(2006.01)**

According to international Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04N 9/69; G09G 5/02; G03G 21/00; G03G 21/14; H04N 9/73; H04N 9/64; G09G 5/00; H04N 9/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models: IPC as above

Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & Keywords: RGB, compensation, camera, display

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Category*</th>
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<th>Relevant to claim No.</th>
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<td>KR 10-2011-0016154 A (LG INNOTEK CO., LTD.) 17 February 2011</td>
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<td>See paragraphs [0018]-[0044], claims 1-3 and figures 2-4.</td>
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![* Special categories of cited documents:

* A* document defining the general state of the art which is not considered to be of particular relevance

* E* earlier application or patent but published on or after the international filing date

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* O* document referring to oral disclosure, use, exhibition or other means

* P* document published prior to the international filing date but later than the priority date claimed

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**Date of the actual completion of the international search**

24 JULY 2015 (24.07.2015)

**Date of mailing of the international search report**

28 JULY 2015 (28.07.2015)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Dojeon, 189 Sono-ro, Dajeon 302-701,
Republic of Korea

Facsimile No. 82-42-472-7140

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