US 20120188265A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2012/0188265 A1
(43) Pub. Date: Jul. 26, 2012
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(54) **IMAGE DISPLAY DEVICE AND METHOD FOR ADJUSTING CORRECTION DATA IN LOOK-UP TABLE**

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(21) Appl. No.: **13/353,656**

(22) Filed: **Jan. 19, 2012**

(30) **Foreign Application Priority Data**

Jan. 25, 2011 (JP) 2011-013348

Publication Classification

(51) **Int. Cl.**
G09G 5/02 (2006.01)

(52) **U.S. Cl.** **345/589**

(57) **ABSTRACT**

An image display device such as LCD television comprises: LUTs (look-up tables) which are tables of correction data for correcting color balance of a displayed image; gain adjustment units for providing gain to input signal values representing brightness levels of red, green and blue colors in image data of the displayed image; and a microcomputer for recalculating the correction data in the LUTs and updating the correction data to the recalculated ones. The microcomputer determines, as adjustment gain values, gain values which are provided to the input signal values by the gain adjustment units and which bring color balance of a white balance adjustment image to a predetermined color balance, and recalculates the correction data in the LUTs based on the correction data and the adjustment gain values. This image display device can increase accuracy of white balance adjustment and reduce time required for the white balance adjustment.

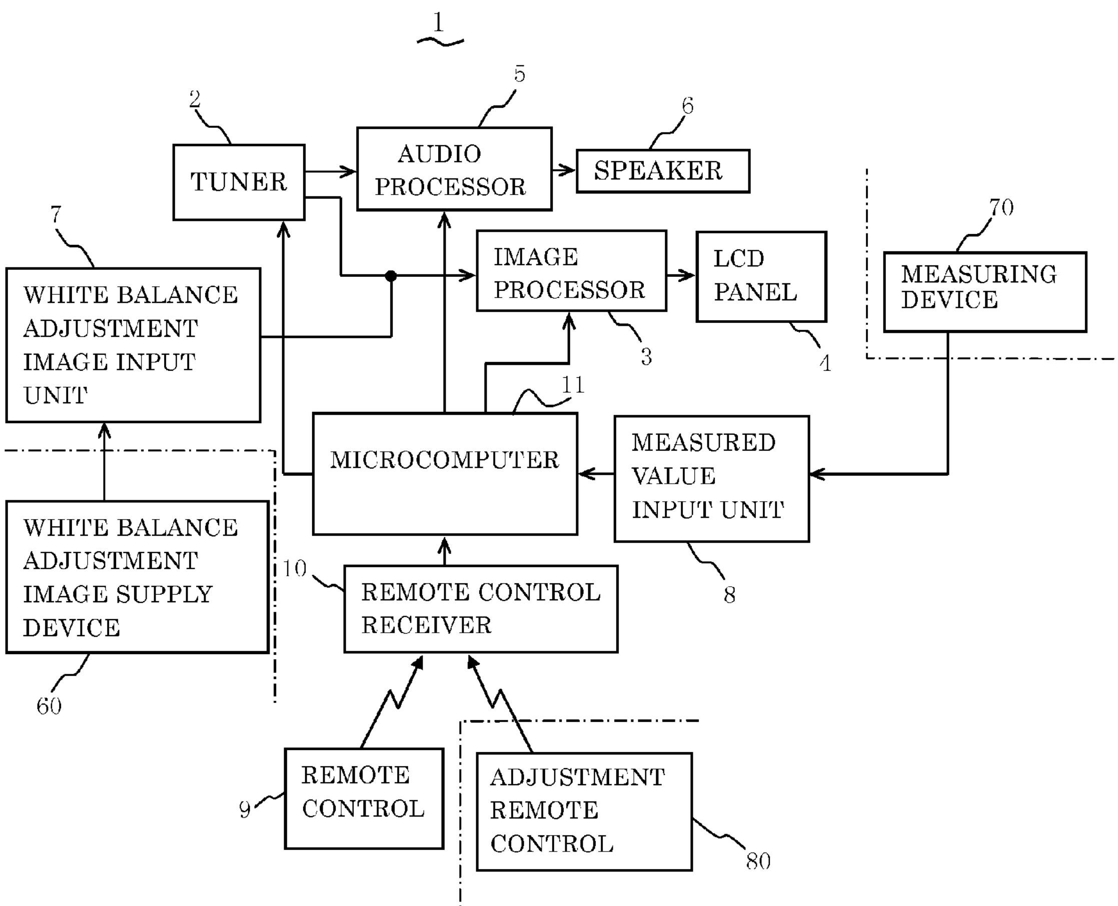


FIG. 1

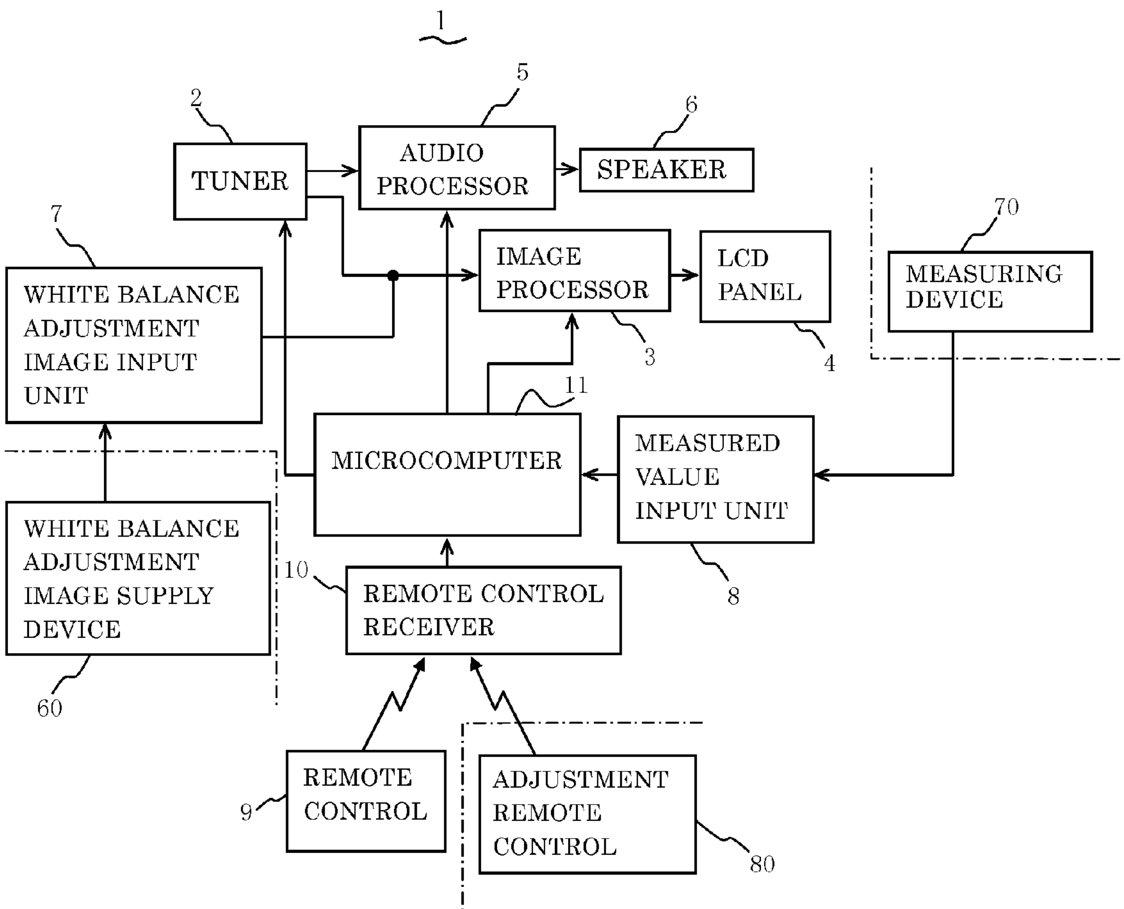

1
2
TUNER
5
AUDIO PROCESSOR
6
SPEAKER
7
WHITE BALANCE ADJUSTMENT IMAGE INPUT UNIT
IMAGE PROCESSOR
3
LCD PANEL
4
70
MEASURING DEVICE
11
MICROCOMPUTER
MEASURED VALUE INPUT UNIT
8
WHITE BALANCE ADJUSTMENT IMAGE SUPPLY DEVICE
60
10
REMOTE CONTROL RECEIVER
9
REMOTE CONTROL
ADJUSTMENT REMOTE CONTROL
80

FIG. 2

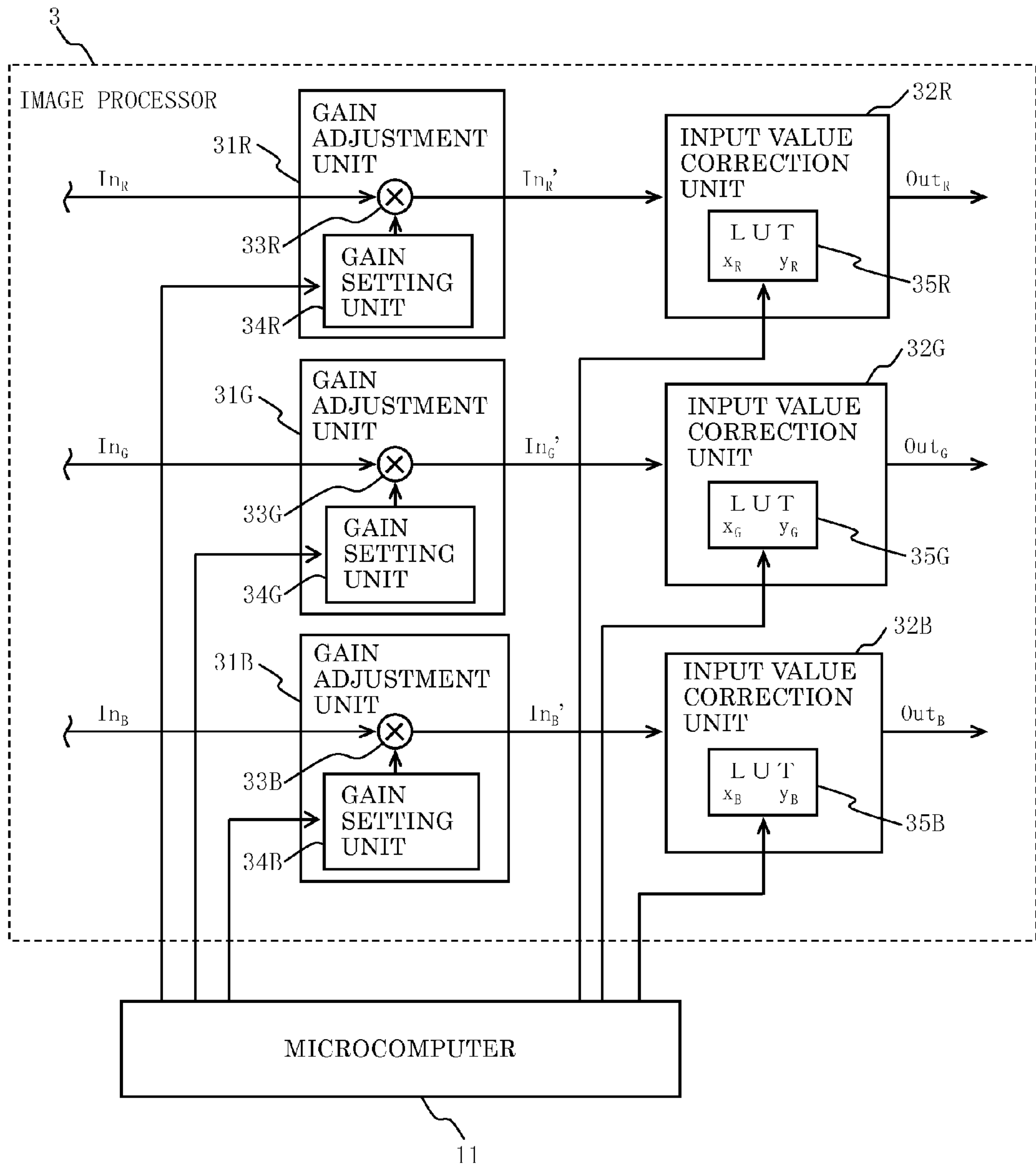

3
IMAGE PROCESSOR
GAIN ADJUSTMENT UNIT
31R
In_R
In_R'
33R
GAIN SETTING UNIT
34R
INPUT VALUE CORRECTION UNIT
32R
Out_R
LUT
x_R y_R
35R
GAIN ADJUSTMENT UNIT
31G
In_G
In_G'
33G
GAIN SETTING UNIT
34G
INPUT VALUE CORRECTION UNIT
32G
Out_G
LUT
x_G y_G
35G
GAIN ADJUSTMENT UNIT
31B
In_B
In_B'
33B
GAIN SETTING UNIT
34B
INPUT VALUE CORRECTION UNIT
32B
Out_B
LUT
x_B y_B
35B
MICROCOMPUTER
11

FIG. 3

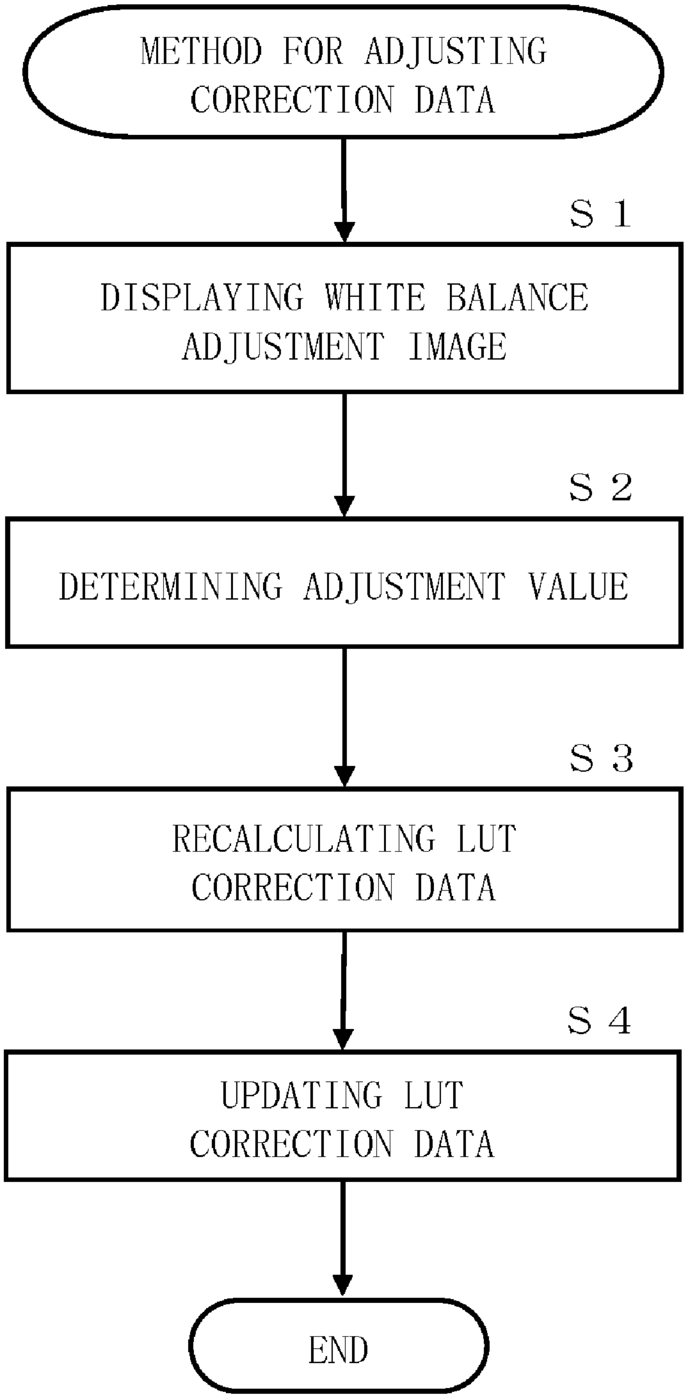

METHOD FOR ADJUSTING CORRECTION DATA
S 1
DISPLAYING WHITE BALANCE ADJUSTMENT IMAGE
S 2
DETERMINING ADJUSTMENT VALUE
S 3
RECALCULATING LUT CORRECTION DATA
S 4
UPDATING LUT CORRECTION DATA
END

FIG. 4

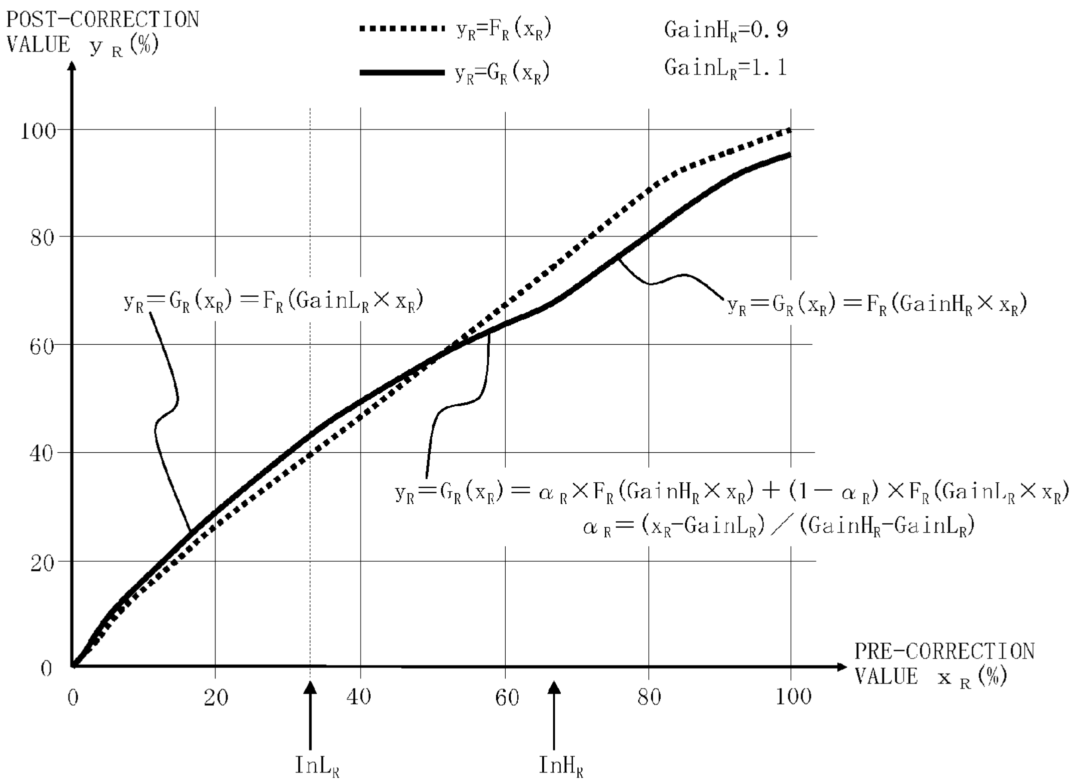
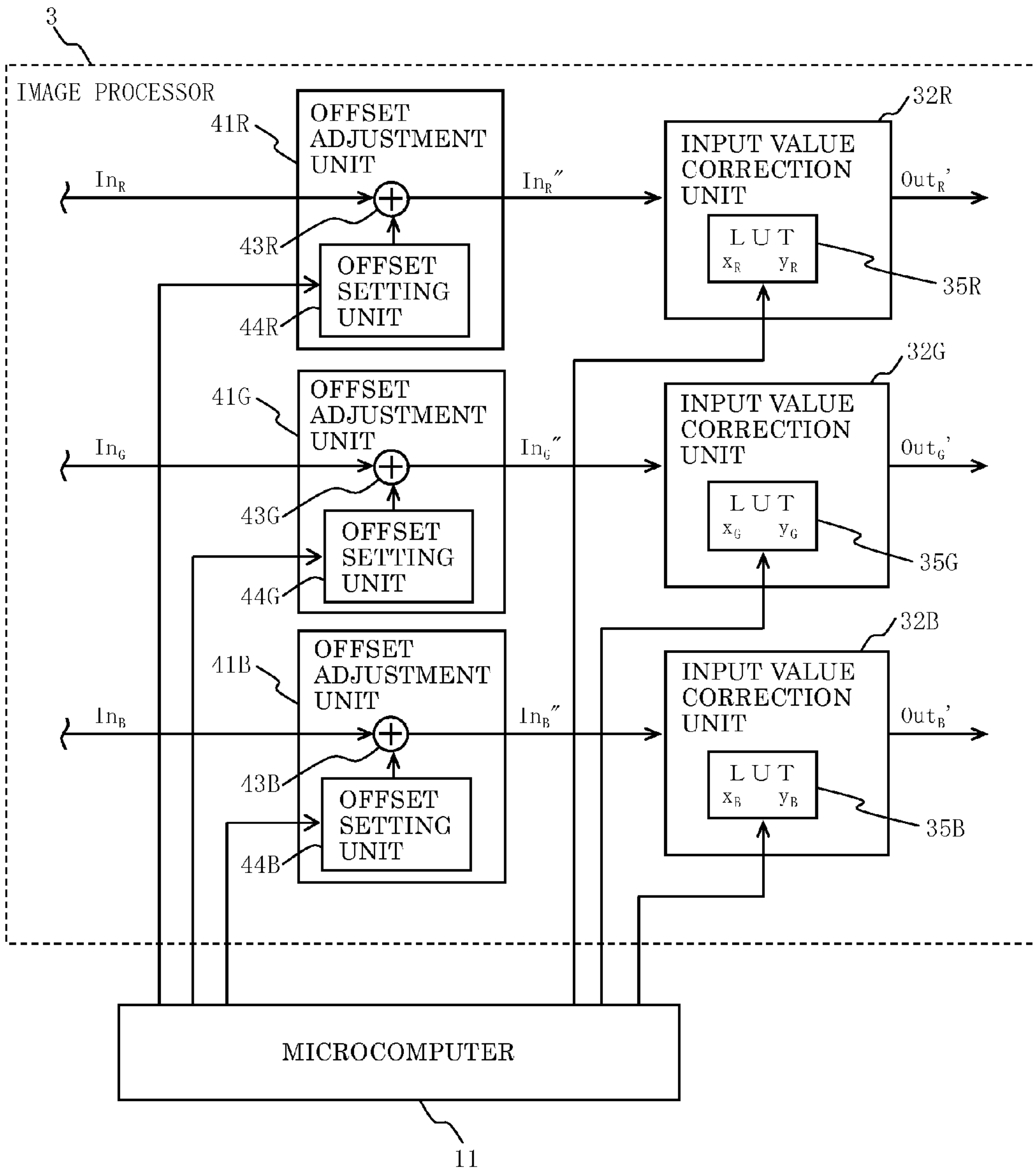

POST-CORRECTION
VALUE y_R (%)
$y_R=F_R(x_R)$
$y_R=G_R(x_R)$
$GainH_R=0.9$
$GainL_R=1.1$
100
80
60
40
20
0
$y_R=G_R(x_R)=F_R(GainL_R \times x_R)$
$y_R=G_R(x_R)=F_R(GainH_R \times x_R)$
$y_R=G_R(x_R)=\alpha_R \times F_R(GainH_R \times x_R)+(1-\alpha_R) \times F_R(GainL_R \times x_R)$
$\alpha_R=(x_R-GainL_R)/(GainH_R-GainL_R)$
0
20
40
60
80
100
PRE-CORRECTION
VALUE x_R (%)
InL_R
InH_R

FIG. 5



3
IMAGE PROCESSOR
41R
OFFSET ADJUSTMENT UNIT
In_R
In_R''
43R
OFFSET SETTING UNIT
44R
32R
INPUT VALUE CORRECTION UNIT
LUT
x_R y_R
Out_R'
35R
41G
OFFSET ADJUSTMENT UNIT
In_G
In_G''
43G
OFFSET SETTING UNIT
44G
32G
INPUT VALUE CORRECTION UNIT
LUT
x_G y_G
Out_G'
35G
41B
OFFSET ADJUSTMENT UNIT
In_B
In_B''
43B
OFFSET SETTING UNIT
44B
32B
INPUT VALUE CORRECTION UNIT
LUT
x_B y_B
Out_B'
35B
MICROCOMPUTER
11

IMAGE DISPLAY DEVICE AND METHOD FOR ADJUSTING CORRECTION DATA IN LOOK-UP TABLE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an image display device for displaying a color image on a color display unit and a method for adjusting correction data in a look-up table (which stores correction data for correcting color balance of a color image and will be hereafter referred to as LUT).

[0003] 2. Description of the Related Art

[0004] Image display devices for displaying color images on a color display unit in the prior art include a so-called liquid crystal display (hereafter referred to as LCD) television, which receives a television signal broadcast from a television broadcast station and displays a color image based on the television signal on an LCD panel as a color display unit. The LCD television comprises an LUT which stores correction data for correcting color balance (hue) of an image to be displayed on the LCD panel (so as to achieve predetermined color balance). It is designed that an image based on a television signal is corrected for color balance based on the correction data in the LUT (so as to achieve predetermined color balance), and then is displayed on the LCD panel. More specifically, such an LCD television is designed to use the correction data in the LUT to correct an input signal value representing a brightness level of each color of red, green and blue in image data of the image based on the television signal (i.e. image data generated from the television signal), so as to display a color image based on the corrected input signal value on the LCD panel.

[0005] Note that correction data in an LUT is calculated and generated using one LCD television called average product and based on color balance of an image displayed on this LCD television. However, there are individual differences among individual LCD televisions. This causes differences in color balance (hue) among resultant images displayed on individual LCD televisions even if the color balance of an image based on the same image data is corrected in the same way based on the same correction data in the LUT in the individual LCD televisions. This means that a color balance of a displayed color image after corrected based on correction data in an LUT may, in some cases, not be a predetermined color balance due to individual differences among individual LCD televisions.

[0006] Thus, an adjustment called white balance adjustment is made in such LCD televisions before shipment in order to eliminate differences in color balance or hue of displayed images due to individual differences among individual LCD televisions, or more specifically to bring a color balance of a displayed color image to a predetermined color balance when the color balance of the displayed image after corrected based on correction data in an LUT is not the predetermined color balance due to the individual differences among the individual LCD televisions. A conventional LCD television is designed such that a gain and an offset are provided to an input signal value representing a brightness level of each color of red, green and blue in given image data (image data generated from a television signal), and each input signal value provided with the gain and the offset is corrected based on correction data in an LUT so as to display a color image on an LCD panel based on each corrected input signal value, and that the white balance adjustment is made (i.e. color balance of the displayed image is brought to a predetermined color balance) by adjusting the gain value and the offset value provided to the input signal value.

[0007] The conventional LCD television comprises a gain adjustment unit for providing gain to an input signal value and an offset adjustment unit for providing offset to the input signal value. The white balance is adjusted by adjusting a gain value of the gain adjustment unit (more specifically, a gain value provided to the input signal value) and adjusting an offset value of the offset adjustment unit (more specifically, an offset value provided to the input signal value) without replacing the LUT by another or updating the correction data of the LUT. This white balance adjustment is made by displaying a predetermined white balance adjustment image (white color or neutral color image with a predetermined brightness level) on the LCD panel, and by adjusting the gain value of the gain adjustment unit and the offset value of the offset adjustment unit so as to bring the color balance of the displayed white balance adjustment image to a predetermined color balance.

[0008] More specifically, image data of a white balance adjustment image is provided to the LCD television from a white balance adjustment image supply device as an external device, so as to provide a gain and an offset (gain of 1 and offset of 0 in an initial state) to an adjustment input value (input value used for adjustment) which is an input signal value representing a brightness level of each color of red, green and blue in the image data of the white balance adjustment image provided to the LCD television. The adjustment input value provided with the gain and the offset is corrected based on the correction data in the LUT, and the white balance adjustment image based on the thus corrected adjustment input value is displayed on the LCD panel. The color balance of the white balance adjustment image displayed on the LCD panel is measured by a measuring device as an external device. The gain value of the gain adjustment unit and the offset value of the offset adjustment unit are adjusted so as to allow the measured color balance value to be in a predetermined range, i.e. bring the color balance of the white balance adjustment image displayed on the LCD panel to a predetermined color balance.

[0009] Even more specifically, as the white balance adjustment image, two white balance adjustment images with different brightness levels (the white balance adjustment image with a lower brightness level being hereafter referred to as Low side white balance adjustment image, and the white balance adjustment image with a higher brightness level being hereafter referred to as High side white balance adjustment image) are displayed on the LCD panel. The gain value of the gain adjustment unit is adjusted to bring the color balance of the High side white balance adjustment image to a predetermined color balance, while the offset value of the offset adjustment unit is also adjusted to bring the color balance of the Low side white balance adjustment image to a predetermined color balance. This is done by repeating a process of displaying the High side white balance adjustment image on the LCD panel and adjusting the gain value of the gain adjustment unit, and a process of displaying the Low side white balance adjustment image on the LCD panel and adjusting the offset value of the offset adjustment unit, whereby the gain value of the gain adjustment unit and the offset value of the offset adjustment unit are adjusted so as to bring the color balance of each of the High side white balance adjustment image and the Low side white balance adjustment image to a predetermined color balance. The white balance adjustment is made in this way.

[0010] In order to display a color image based on a television signal after the white balance adjustment is made, the thus adjusted gain value and the offset value are used to provide a gain and an offset to the input signal value representing a brightness level of each color of red, green and blue in the image data of the color image to be displayed, and each input signal value provided with the gain and the offset is corrected based on the correction data in the LUT so as to display a color image on the LCD panel based on each corrected input signal value. Here, the gain value and the offset value after adjusted by the white balance adjustment are equally applied to the entire range of the input signal value, so that a gain and an offset based on the thus adjusted gain value and offset value are equally provided to the input signal value representing a brightness level of each color of red, green and blue in the image data of the image to be displayed.

[0011] However, the conventional white balance adjustment described above has the following problems. (1) First, as described above, an offset is equally provided to an input signal value representing a brightness level of each color of red, green and blue in image data of an image to be displayed. Thus, when the input signal value is low (particularly when it is lower than the Low side adjustment input value), the color accuracy of the displayed image is lowered (the color balance of the displayed image is caused to shift from the predetermined color balance). For example, when the offset value provided to the input signal value representing the brightness level of red is a positive value, the displayed image is caused to take on reddish color, more than expected, in dark areas (areas of the displayed image with low brightness) including black.

[0012] (2) Second, the gain adjustment by displaying the High side white balance adjustment image and the offset adjustment by displaying the Low side white balance adjustment image influence each other. This increases time for the adjustment because it is required to repeat many times the offset adjustment process to bring the color balance of the Low side white balance adjustment image to a predetermined color balance as well as the gain adjustment process to bring the color balance of the High side white balance adjustment image to a predetermined color balance until the color balance of both Low side and High side white balance adjustment images is brought to a standard value (predetermined color balance) (more specifically, until it becomes possible to determine the gain value and the offset value which bring the color balance of both Low side and High side white balance adjustment images to the predetermined color balance).

[0013] Thus, according to the conventional white balance adjustment, displayed images have low color accuracy after the white balance adjustment. In other words, the white balance adjustment has low accuracy. Further, it requires a long time for the white balance adjustment. Although the problems of white balance adjustment have been described above using an LCD panel as an example, similar problems can be found in other image display devices for displaying color images on a color display unit such as plasma display panels, CRT (Cathode Ray Tube) display panels and organic EL (Electroluminescence) display panels. The following describes some other technologies of white balance and other adjustments in the prior art.

[0014] Japanese Laid-open Patent Publication Hei 5-236498 discloses an automatic white balance adjusting device which sets a reference gain data and a reference DC offset data as an initial value to be used as a reference for white balance adjustment. It detects a gain error between the reference gain data and a bright screen data which is an electrical signal converted from a bright screen determining a gain, and also detects an offset error between the reference DC offset data and a dark screen data which is an electrical signal converted from a dark screen determining a DC offset. The gain and the offset are controlled to null the gain error and the offset error so as to make white balance adjustment.

[0015] Japanese Laid-open Patent Publication 2001-238227 discloses a method of tone correction. It measures contrast, and sets a dynamic range of contrast which can be used for display, and further makes gain adjustment and offset adjustment adapted to the dynamic range. Thereafter, it recalculates and writes data in an LUT to achieve full dynamic range, thereby generating tone correction data. Further, Japanese Laid-open Patent Publication Hei 7-64522 discloses an automatic adjusting system for a multi-display device which has multiple display units combined to form a large screen display, and which makes white balance adjustment by allowing a camera to detect amounts of red, green and blue light from the multiple display units. However, such technologies disclosed in the prior art do not solve the above problems.

BRIEF SUMMARY OF THE INVENTION

[0016] An object of the present invention is to provide an image display device and a method for adjusting correction data in a look-up table (hereafter referred to as LUT) that are able to increase accuracy of white balance adjustment and to reduce the time required for white balance adjustment.

[0017] According to a first aspect of the present invention, this object is achieved by an image display device comprising: a color display unit for displaying a color image; and an LUT which stores correction data for correcting color balance of the color image to be displayed on the color display unit. When a color image based on input image data is displayed on the color display unit, an input signal value representing a brightness level of each color of red, green and blue in the input image data is corrected based on the correction data in the LUT so as to display a color image based on the corrected input signal value on the color display unit. Further, the image display device further comprises: LUT correction data recalculating means for recalculating the correction data in the LUT based on the correction data; and LUT correction data updating means for updating the correction data in the LUT to the correction data recalculated by the LUT correction data recalculating means.

[0018] According to a preferred mode of the present invention, the image display device further comprises gain adjusting means for providing gain to an adjustment input value which is an input signal value representing a brightness level of each color of red, green and blue in image data of a white balance adjustment image to be used for recalculating the correction data in the LUT. When the adjustment image is displayed on the color display unit, the gain adjusting means provides a gain to the adjustment input value to generate a gain-modified adjustment input value, and the gain-modified adjustment input value is then corrected based on the correction data in the LUT so as to display a white balance adjustment image based on the corrected gain-modified input value. A gain value, which is provided to the adjustment input value by the gain adjusting means and which brings color balance of the white balance adjustment image displayed on the color display unit to a predetermined color balance, is determined as an adjustment gain value. Further, the LUT correction data recalculating means recalculates the correction data in the LUT based on the correction data and the adjustment gain value.

[0019] Preferably, the white balance adjustment image comprises a plurality of different white balance adjustment images, and the LUT correction data recalculating means recalculates the correction data in the LUT based on the correction data and the adjustment gain values for the plurality of white balance adjustment images.

[0020] Further preferably, the correction data in the LUT represents a relationship between a pre-correction value representing a pre-correction brightness level of each color of red, green and blue and a post-correction value representing a brightness level to be output after correcting the pre-correction value. The number of the plurality of white balance adjustment images is two. Assuming that x denotes the pre-correction value, y=F(x) denotes the post-correction value before recalculation by the LUT correction data recalculating means, and further y=G(x) denotes the post-correction value after recalculation by the LUT correction data recalculating means, the LUT correction data recalculating means recalculates the post-correction value y=G(x) in the LUT as:

$$y=G(x)=F(\mathrm{Gain}L\times x) \text{ in the range of } x\leqq InL;$$

$$y=G(x)=\alpha\times F(\mathrm{Gain}H\times x)+(1-\alpha)\times F(\mathrm{Gain}L\times x) \text{ in the range of } InL<x<InH; \text{ and}$$

$$y=G(x)=F(\mathrm{Gain}H\times x) \text{ in the range of } InH\leqq x$$

where InL denotes the adjustment input value in image data of a Low side white balance adjustment image which is one of the two white balance adjustment images with a lower brightness level while InH denotes the adjustment input value in image data of a High side white balance adjustment image which is the other of the two white balance adjustment images with a higher brightness level, and where GainL denotes the adjustment gain value which brings color balance of the Low side white balance adjustment image to a predetermined color balance while GainH denotes the adjustment gain value which brings color balance of the High side white balance adjustment image to a predetermined color balance, and further where a denotes the quotient of (x−GainL)/(GainH−GainL).

[0021] According to another preferred mode of the present invention, the image display device further comprises offset adjusting means for providing offset to an adjustment input value which is an input signal value representing a brightness level of each color of red, green and blue in image data of a white balance adjustment image to be used for recalculating the correction data in the LUT. When the adjustment image is displayed on the color display unit, the offset adjusting means provides an offset to the adjustment input value to generate an offset-modified adjustment input value, and the offset-modified adjustment input value is then corrected based on the correction data in the LUT so as to display a white balance adjustment image based on the corrected offset-modified input value. An offset value, which is provided to the adjustment input value by the offset adjusting means and which brings color balance of the white balance adjustment image displayed on the color display unit to a predetermined color balance, is determined as an adjustment offset value. Further, the LUT correction data recalculating means recalculates the correction data in the LUT based on the correction data and the adjustment offset value.

[0022] According to a second aspect of the present invention, the object is achieved by a method for adjusting correction data in an LUT (look-up table) which stores correction data for correcting color balance of a color image to be displayed on a color display unit, in which the correction data in the LUT represents a relationship between a pre-correction value representing a pre-correction brightness level of each color of red, green and blue and a post-correction value representing a brightness level to be output after correcting the pre-correction value, the method comprising the steps of: displaying, on the color display unit, a white balance adjustment image to be used for adjusting the correction data in the LUT after using the correction data in the LUT to correct an adjustment input value which is an input signal value representing a brightness level of each color of red, green and blue in image data of the white balance adjustment image; determining, as an adjustment gain value or an adjustment offset value, a gain value or an offset value to bring color balance of the white balance adjustment image displayed on the color display unit to a predetermined color balance after providing a gain or an offset to the adjustment input value and adjusting the gain or the offset so as to bring the color balance of the displayed white balance adjustment image to the predetermined color balance; recalculating the correction data in the LUT based on the correction data and the adjustment gain value or the adjustment offset value; and updating the correction data in the LUT to the recalculated correction data.

[0023] According to the first and second aspects of the present invention described above, it is possible in each image display device to appropriately update correction data in the LUT for correcting each input signal value representing a brightness level of each color of red, green and blue in image data of an image to be displayed. Thus, it is possible to correct each input signal value based on the correction data, which has been updated to be appropriate for each image display device, in the LUT over the entire range of the each input signal value representing the brightness level of each color of red, green and blue in the image data of the image to be displayed. This makes it possible to increase color accuracy of the displayed image (i.e. to bring the color balance of the displayed image to a predetermined color balance) after the white balance adjustment is made, thereby increasing accuracy of the white balance adjustment.

[0024] Furthermore, according to the present invention, the white balance adjustment is made by recalculating and updating correction data in the LUT, in which the recalculation and updating of the correction data in the LUT can be performed in a short time, thereby making it possible to reduce time required for white balance adjustment. In addition, it is only required to change software in a conventional image display device without need to change the hardware structure of the image display device. Thus, it is possible to achieve the increase in the accuracy of white balance adjustment and reduce the time required for the white balance adjustment without increasing the cost of the image display device.

[0025] While the novel features of the present invention are set forth in the appended claims, the present invention will be better understood from the following detailed description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The present invention will be described hereinafter with reference to the annexed drawings. It is to be noted that all the drawings are shown for the purpose of illustrating the technical concept of the present invention or embodiments thereof, wherein:

[0027] FIG. **1** is a schematic block diagram of an LCD television according to an embodiment of the present invention;

[0028] FIG. **2** is a schematic block diagram of an example of an image processor with a microcomputer in the LCD television;

[0029] FIG. **3** is a flow chart showing a method for adjusting correction data in LUTs in the image processor;

[0030] FIG. **4** is a graph showing an example of correction data in an LUT; and

[0031] FIG. **5** is a schematic block diagram of a modified example of the image processor with the microcomputer in the LCD television.

DETAILED DESCRIPTION OF THE INVENTION

[0032] Embodiments of the present invention, as best mode for carrying out the invention, will be described hereinafter with reference to the drawings. The present invention relates to an image display device and a method for adjusting correction data in an LUT (look-up table). It is to be understood that the embodiments described herein are not intended as limiting, or encompassing the entire scope of, the present invention. Note that like parts are designated by like reference numerals, characters or symbols throughout the drawings.

[0033] FIG. **1** is a schematic block diagram of an LCD (liquid crystal display) television **1** which is an example of an image display device according to an embodiment of the present invention. The LCD television **1** is a device for receiving a television signal broadcast from a television broadcast station so as to display an image (color image) and output sound based on the television signal. The LCD television **1** comprises an LUT which stores correction data for correcting color balance (hue) of a color image to be displayed on an LCD panel **4** (for correction to achieve predetermined color balance). The LCD television **1** is designed such that the color balance of the image based on a television signal is corrected based on the correction data in the LUT, and then the image is displayed on the LCD panel **4**.

[0034] The LCD television **1** has a function to make white balance adjustment, which is to eliminate differences in color balance or hue of the displayed image due to individual differences among individual LCD televisions (among individual LCD panels), or more specifically to bring color balance of the displayed image to a predetermined color balance when the color balance of the displayed image after corrected based on correction data in an LUT is not a predetermined color balance due to the individual differences among the individual LCD televisions. According to the present embodiment, the white balance adjustment is made by adjusting (more specifically by recalculating and updating) correction data in the LUT.

[0035] The LCD television **1** makes white balance adjustment by using a white balance adjustment image supply device **60** as an external device, a measuring device **70** and an adjustment remote control **80**. The white balance adjustment image supply device **60** outputs white balance adjustment image data as image data of a white balance adjustment image to be used to make white balance adjustment (more specifically to recalculate correction data in an LUT). The measuring device **70** measures color balance of an image to be measured, and outputs a measured color balance value. The adjustment remote control **80** is operated by a person to make the adjustment, who commands various operations for making the white balance adjustment, so as to transmit operation signals indicating content of the operations by using a wireless signal.

[0036] The LCD television **1** comprises a tuner **2**, an image processor **3**, an LCD panel **4** as a color display unit, an audio processor **5**, a speaker **6**, a white balance adjustment image input unit **7**, a measured value input unit **8**, a remote control **9**, a remote control receiver **10**, a microcomputer **11** for controlling the operation of the LCD television **1**, and so on. Under the control of the microcomputer **11**, the tuner **2** receives a television signal broadcast from a television broadcast station, and generates image data of a color image based on the television signal and audio data of sound also based on the television signal. Under the control of the microcomputer **11**, the image processor **3** subjects the image data generated by the tuner **2** to various image data processing, and supplies the processed image data to the LCD panel **4**. The LCD panel **4** displays a color image based on the image data supplied from the image processor **3**. Further, under the control of the microcomputer **11**, the audio processor **5** subjects the audio data generated by the tuner **2** to various audio data processing, and supplies the processed audio data to the speaker **6**. The speaker **6** outputs sound based on the audio data supplied from the audio processor **5**.

[0037] The remote control **9** is operated by a user to command various operations of the LCD television **1** so as to transmit operation signals indicating the content of the operations by using infrared. The remote control receiver **10** receives the operation signals transmitted from the remote control **9**, and also receives the operation signals transmitted from the adjustment remote control **80**. The white balance adjustment image input unit **7** is used to make the white balance adjustment, and is connected to the white balance adjustment image supply device **60** so as to allow white balance adjustment image data output from the white balance adjustment image supply device **60** to be input to the white balance adjustment image input unit **7**. The measured value input unit **8** is also used to make the white balance adjustment, and is connected to the measuring device **70** so as to allow the measured color balance value output from the measuring device **70** to be input to the measured value input unit **8**. The microcomputer **11** controls various operations of the LCD television **1** including those described above.

[0038] FIG. **2** is a schematic block diagram of an example of the image processor **3** with the microcomputer **11** in the LCD television **1**. The image processor **3** comprises gain adjustment units **31**R, **31**G, **31**B and input value correction units **32**R, **32**G, **32**B as well as various signal processing units (not shown). Input to the image processor **3** is image data of an image based on a television signal generated by the tuner **2**, or image data of a white balance adjustment image input from the white balance adjustment image input unit **7**. The image data input to the image processor **3** is subjected to various signal processing by the various signal processing units (not shown). Input signal values In_R, In_G, In_B representing brightness levels of respective colors of red, green and blue in the input and processed image data are input to the gain adjustment units **31**R, **31**G **31**B. The gain adjustment units **31**R, **31**G, **31**B serve to provide gain to the input signal values In_R, In_G, In_B representing brightness levels of respective colors of red, green and blue in the image data. The gain adjustment unit **31**R comprises a multiplier circuit **33**R and a gain setting unit **34**R, and the gain adjustment unit **31**G comprises a multiplier circuit **33**G and a gain setting unit **34**G, while the gain adjustment unit **31**B comprises a multiplier circuit **33**B and a gain setting unit **34**B.

[0039] The multiplier circuit **33**R of the gain adjustment unit **31**R multiplies the input signal value In_R representing the brightness level of red by a gain value set in the gain setting unit **34**R so as to provide a gain to the input signal value In_R (input signal value In_R provided with a gain being hereafter referred to as gain-modified input signal value In_R'). The multiplier circuit **33**G of the gain adjustment unit **31**G multiplies the input signal value In_G representing the brightness level of green by a gain value set in the gain setting unit **34**G so as to provide a gain to the input signal value In_G (input signal value In_G provided with a gain being hereafter referred to as gain-modified input signal value In_G'). Similarly, the multiplier circuit **33**B of the gain adjustment unit **31**B multiplies the input signal value In_B representing the brightness level of blue by a gain value set in the gain setting unit **34**B so as to provide a gain to the input signal value In_B (input signal value In_B provided with a gain being hereafter referred to as gain-modified input signal value In_B'). The gain-modified input signal values In_R', In_G', In_B' (i.e. the input signal values In_R, In_G, In_B provided with the gain by the gain adjustment units **31**R, **31**G **31**B that are output signal values of the gain adjustment units **31**R, **31**G, **31**B) are respectively input to the input value correction units **32**R, **32**G **32**B.

[0040] The input value correction units **32**R, **32**G **32**B serve to correct color balance of a color image to be displayed on the LCD panel **4**. The input value correction units **32**R, **32**G, **32**B respectively comprise an LUT **35**R, an LUT **35**G and an LUT **35**B. Each of the LUTs **35**R, **35**G, **35**B is a table of correction data for correcting color balance of the color image to be displayed on the LCD panel **4**. The correction data in the LUTs **35**R, **35**G **35**B represent relationships between pre-correction values representing pre-correction brightness levels of the respective colors of red, green and blue and post-correction values representing brightness levels to be output after correcting the pre-correction values, respectively.

[0041] More specifically, the correction data in the LUT **35**R represents a relationship between a pre-correction value x_R representing a pre-correction brightness level of the red color and a post-correction value y_R representing a brightness level of the red color to be output after correcting the pre-correction value x_R. The correction data in the LUT **35**G represents a relationship between a pre-correction value x_G representing a pre-correction brightness level of the green color and a post-correction value y_G representing a brightness level of the green color to be output after correcting the pre-correction value x_G. Similarly, the correction data in the LUT **35**B represents a relationship between a pre-correction value x_B representing a pre-correction brightness level of the blue color and a post-correction value y_B representing a brightness level of the blue color to be output after correcting the pre-correction value x_B.

[0042] The input value correction units **32**R **32**G **32**B correct the gain-modified input signal values In_R', In_G', In_B' based on the correction data in the LUTs **35**R, **35**G **35**B, respectively. More specifically, the input value correction unit **32**R uses the LUT **35**R as a reference to output, as an output signal value OUT_R, a post-correction value y_R which corresponds to a pre-correction value x_R equal to the gain-modified input signal value In_R'. The input value correction unit **32**G uses the LUT **35**G as a reference to output, as an output signal value OUT_G, a post-correction value y_G which corresponds to a pre-correction value x_G equal to the gain-modified input signal value In_G'. Similarly, the input value correction unit **32**B uses the LUT **35**B as a reference to output, as an output signal value OUT_B, a post-correction value y_B which corresponds to a pre-correction value x_B equal to the gain-modified input signal value In_B'. The output values OUT_R, OUT_G, OUT_B output from the input value correction units **32**R **32**G, **32**B (i.e. input signal values after corrected by the input value correction units **32**R **32**G, **32**B) are supplied to the LCD panel **4** so that an image based on the output signal values OUT_R, OUT_G, OUT_B is displayed on the LCD panel **4**.

[0043] According to LCD television **1** of the present embodiment using the thus formed image processor **3**, when an image based on given image data (more specifically, an image based on a television signal or a white balance adjustment image) is displayed on the LCD panel **4**, the gain adjustment units **31**R, **31**B, **31**G provide gain to the input signal values In_R, In_G, In_B representing brightness levels of respective colors of red, green and blue in the image data of such image. The gain-modified input signal values In_R', In_G', In_B' (input signal values In_R, In_G, In_B provided with the gain) are corrected based on the correction data in the LUTs **35**R, **35**G, **35**B, and an image based on the thus corrected input signal values (i.e. the output signal values OUT_R, OUT_G, OUT_B) is displayed on the LCD panel **4**.

[0044] The gain values of the gain setting units **34**R, **34**G, **34**B are set under the control of the microcomputer **11**. More specifically, the microcomputer **11** controls adjustment of the gain value provided by the gain adjustment unit **31**R to the input signal value In_R, and adjustment of the gain value provided by the gain adjustment unit **31**G to the input signal value In_G as well as adjustment of the gain value provided by the gain adjustment unit **31**B to the input signal value In_B. Other than when displaying a white balance adjustment image, the microcomputer **11** sets the gain value of each of the gain setting units **34**R, **34**G, **34**B to 1 (one). In other words, when displaying images (based on a television signal) other than a white balance adjustment image, the input signal values In_R, In_G, In_B before provided with the gain are equal to the gain-modified input signal values In_R', In_G', In_B' (input signal values In_R, In_G, In_B provided with the gain), respectively.

[0045] Next, the white balance adjustment will be described. According to the present embodiment, the white balance adjustment is made by adjusting (more specifically by recalculating and updating) correction data in the LUTs **35**R, **35**G **35**B. FIG. **3** is a flow chart showing a method for adjusting correction data in the LUTs **35**R, **35**G, **35**B. Referring to FIG. **3**, the method for adjusting correction data in the LUTs **35**R, **35**G, **35**B comprises the steps of: displaying a white balance adjustment image (S1) to display a predetermined white balance adjustment image (white color or neutral color image with a predetermined brightness level) on the LCD display **4**; determining an adjustment value (S2) to determine, as an adjustment gain value (adjustment value), a gain value of each of the gain adjustment units **31**R, **31**G, **31**B which value brings the color balance of the white balance adjustment image displayed on the LCD panel **4** to a predetermined color balance; recalculating an LUT correction data

(S**3**) to recalculate the correction data in the LUTs **35**R, **35**G, **35**B based on the correction data and the adjustment gain value; and updating an LUT correction data (S**4**) to update the correction data in the LUTs **35**R, **35**G **35**B to the recalculated correction data.

[0046] The method for adjusting correction data according to the present embodiment allows two white balance adjustment images with different brightness levels to be displayed as the white balance adjustment image on the LCD panel **4**, and determines adjustment gain values for the two different white balance adjustment images, and further recalculates correction data in the LUTs **35**R, **35**G **35**B based on the correction data and the adjustment gain values for the two different white balance adjustment images with different brightness levels. Thereafter, the correction data in the LUTs **35**R, **35**G, **35**B are updated to the recalculated correction data. In the following, one of the two white balance adjustment images with a lower brightness level and the other of the two white balance adjustment images with a higher brightness level will be respectively referred to as Low side white balance adjustment image and High side white balance adjustment image. Further, adjustment input values (input values used for adjustment) for red, green and blue color in the image data of the Low side white balance adjustment image will be respectively referred to as Low side adjustment input values InL_R, InL_G, InL_B, while adjustment input values for red, green and blue color in the image data of the High side white balance adjustment image will be respectively referred to as High side adjustment input values InH_R, InH_G, InH_B.

[0047] Further, adjustment gain values for red, green and blue color which bring the color balance of the Low side white balance adjustment image displayed on the LCD panel **4** to a predetermined color balance will be respectively referred to as Low side adjustment gain values $GainL_R$, $GainL_G$, $GainL_B$, while adjustment gain values for red, green and blue color which bring the color balance of the High side white balance adjustment image displayed on the LCD panel **4** to a predetermined color balance will be respectively referred to as High side adjustment gain values $GainH_R$, $GainH_G$, $GainH_B$. Further, the quotient of $(x_R-GainL_R)/(GainH_R-GainL_R)$ will be denoted by α_R, and the quotient of $(x_G-GainL_G)/(GainH_G-GainL_G)$ will be denoted by α_G, while the quotient of $(x_B-GainL_B)/(GainH_B-GainL_B)$ will be denoted by α_B. Here, x_R, x_G, x_B respectively denote pre-correction values representing pre-correction brightness levels of red, green and blue color in the LUTs **35**R, **35**G, **35**B. On the other hand, post-correction values (representing post-correction brightness levels of red, green and blue output after correcting x_R, x_G, x_B) in the LUTs **35**R, **35**G, **35**B, before recalculation, will be respectively denoted by $y_R=F_R(x_R)$, $y_G=F_G(x_G)$, $y_B=F_B(x_B)$, while post-correction values (representing post-correction brightness levels of red, green and blue output after correcting x_R, x_G, x_B) in the LUTs **35**R, **35**G, **35**B, after recalculation, will be respectively denoted by $y_R=G_R(x_R)$, $y_G=G_G(x_G)$, $y_B=G_B(x_B)$.

[0048] The operation of the microcomputer **11** is as follows. For red color, the microcomputer **11** recalculates the post-correction value $y_R=G_R(x_R)$ in the LUT **35**R as:

$$y_R=G_R(x_R)-F_R(\mathrm{Gain}L_R \times x_R) \text{ in the range of } x_{R \leqq InLR};$$

$$y_R=G_R(x_R)-\alpha_R \times F_R(\mathrm{Gain}H_R \times x_R)+(1-\alpha_R) \times F_R(\mathrm{Gain}L_R \times x_R) \text{ in the range of } InL_R<x_R<InH_R; \text{ and}$$

$$y_R=G_R(x_R)=F_R(\mathrm{Gain}H_R \times x_R) \text{ in the range of } InH_R \leqq x_R.$$

Then, the microcomputer **11** updates the correction data in the LUT **35**R to the recalculated correction data. In a similar manner, the microcomputer **11** recalculates the post-correction value $y_G=G_G(x_G)$ in the LUT **35**G for green color and the post-correction value $y_B=G_B(x_B)$ in the LUT **35**B for blue color, and then updates the correction data in the LUT **35**G and LUT **35**B to the recalculated correction data, respectively.

[0049] The microcomputer **11** forms LUT correction data recalculating means and LUT correction data updating means according to the present invention, i.e. LUT correction data recalculating means for recalculating the correction data based on the correction data stored in each LUT, and LUT correction data updating means for updating the correction data stored in each LUT to the correction data recalculated by the LUT correction data recalculating means. Further, the microcomputer **11** and the gain adjustment units **31**R, **31**G, **31**B form gain adjusting means according to the present invention, i.e. gain adjusting means for providing gain to an adjustment input value which is an input signal value representing a brightness level of each color of red, green and blue in image data of a white balance adjustment image to be used for recalculating the correction data in each LUT.

[0050] Adjustment of the correction data in the LUTs **35**R, **35**G, **35**B is made as follows. First, a person (hereafter referred to as operator) to make the adjustment connects the white balance adjustment image supply device **60** to the white balance adjustment image input unit **7**, and also connects the measuring device **70** to the measured value input unit **8**. Subsequently, the operator operates to output image data of a Low side white balance adjustment image from the white balance adjustment image supply device **60**. Thereby, the image data of the Low side white balance adjustment image is input from the white balance adjustment image input unit **7**, and gain is provided by the gain adjustment units **31**R, **31**G, **31**B to the Low side adjustment input values InL_R, InL_G, InL_B, which are input signal values In_R, In_G, In_B representing brightness levels of respective colors of red, green and blue in the image data of the Low side white balance adjustment image (Low side adjustment input values InL_R, InL_G, InL_B each provided with a gain being hereafter referred to as gain-modified Low side adjustment input values InL_R' InL_G', InL_B, respectively). The gain-modified Low side adjustment input values InL_R' InL_G', InL_B' are corrected based on the correction data in the LUTs **35**R, **35**G, **35**B, and a Low side white balance adjustment image based on the thus corrected gain-modified Low side adjustment input values is displayed on the LCD panel **4** (S**1**: Displaying White Balance Adjustment Image). The Low side adjustment input values InL_R, InL_G, InL_B are e.g. designed to be 33 percent of the maximum possible values of the input signal values In_R, In_G, In_B, respectively.

[0051] The operator then uses the measuring device **70** to measure color balance of the Low side white balance adjustment image displayed on the LCD panel **4**. The measured color balance value of the Low side white balance adjustment image measured by the measuring device **70** is input to the measured value input unit **8**. Further, the operator operates the adjustment remote control **80** to command to determine Low side adjustment gain values $GainL_R$, $GainL_G$, $GainL_B$. In response, based on the measured color balance value input from the measured value input unit **8**, the microcomputer **11** adjusts the gain values of the gain adjustment units **31**R, **31**G, **31**B (i.e. gain values to be provided to the Low side adjustment input values InL_R, InL_G, InL_B) so as to allow the measured color balance value to be in a predetermined range, i.e. bring the color balance of the Low side white balance adjustment image displayed on the LCD panel **4** to a predetermined color balance.

[0052] The color balance of the Low side white balance adjustment image displayed on the LCD panel **4** varies with the adjustment of the gain value of each of the gain adjustment units **31**R, **31**G **31**B, and in turn, the measured color balance value input to the measured value input unit **8** varies with the color balance of the Low side white balance adjustment image displayed on the LCD panel **4**. The gain values to allow the measured color balance value to be in a predetermined range, i.e. the gain values to bring the color balance of the Low side white balance adjustment image displayed on the LCD panel **4** to a predetermined color balance, are determined by the microcomputer **11** as the Low side adjustment gain values $GainL_R$, $GainL_G$, $GainL_B$ (S**2**: Determining Adjustment Value).

[0053] Subsequently, the operator operates to output image data of a High side white balance adjustment image from the white balance adjustment image supply device **60**. Thereby, the image data of the High side white balance adjustment image is input from the white balance adjustment image input unit **7**, and gain is provided by the gain adjustment units **31**R, **31**G, **31**B to the High side adjustment input values InH_R, InH_G, InH_B, which are input signal values In_R, In_G, In_B representing brightness levels of respective colors of red, green and blue in the image data of the High side white balance adjustment image (High side adjustment input values InH_R, InH_G, InH_B each provided with a gain being hereafter referred to as gain-modified High side adjustment input values InH_R' InH_G', InH_B, respectively). The gain-modified High side adjustment input values InH_R' InH_G', InH_B' are corrected based on the correction data in the LUTs **35**R, **35**G **35**B, and a High side white balance adjustment image based on the thus corrected gain-modified High side adjustment input values is displayed on the LCD panel **4** (S**1**: Displaying White Balance Adjustment Image). The High side adjustment input values InH_R, InH_G, InH_B are, for example, designed to be 66 percent of the maximum possible values of the input signal values In_R, In_G, In_B, respectively.

[0054] The operator then uses the measuring device **70** to measure color balance of the High side white balance adjustment image displayed on the LCD panel **4**. The measured color balance value of the High side white balance adjustment image measured by the measuring device **70** is input to the measured value input unit **8**. Further, the operator operates the adjustment remote control **80** to command to determine High side adjustment gain values $GainH_R$, $GainH_G$, $GainH_B$. Thus, similarly as in the case of Low side white balance adjustment, the gain values to allow the measured color balance value to be in a predetermined range, i.e. the gain values to bring the color balance of the High side white balance adjustment image displayed on the LCD panel **4** to a predetermined color balance, are determined by the microcomputer **11** as the High side adjustment gain values $GainH_R$, $GainH_G$, $GainH_B$ (S**2**: Determining Adjustment Value).

[0055] Further, the operator operates the adjustment remote control **80** to command to adjust correction data in the LUTs **35**R, **35**G, **35**B. In response, the microcomputer **11** recalculates the correction data in the LUTs **35**R, **35**G **35**B based on the correction data, the Low side adjustment gain values $GainL_R$, $GainL_G$, $GainL_B$ and the High side adjustment gain values $GainH_R$, $GainH_G$, $GainH_B$ (S**3**: Recalculating LUT Correction Data), and updates the correction data to the recalculated correction data (S**4**: Updating LUT Correction Data). Thereafter, the microcomputer **11** sets the gain value of each of the gain setting units **34**R, **34**G, **34**B to 1 (one). The adjustment of the correction data in the LUTs **35**R, **35**G **35**B (i.e. white balance adjustment) is made in this way.

[0056] FIG. **4** is a graph showing an example of correction data in the LUT **35**R, in which the horizontal axis represents pre-correction values x_R representing pre-correction brightness levels of red color, and the vertical axis represents post-correction values y_R representing brightness levels of the red color to be output after correcting the pre-correction values x_R. In FIG. **4**, the curve $y_R=F_R(x_R)$ shows post-correction values before recalculation, while the curve $y_R=G_R(x_R)$ shows post-correction values after recalculation. The graph shows the correction data assuming that the minimum and maximum values of brightness level are 0 and 100, respectively. In the graph, the curve $y_R=G_R(x_R)$ shown was obtained by recalculating the curve $y_R=F_R(x_R)$ shown, in which the white balance adjustment was made by setting the Low side adjustment input value InL_R to 33 percent of the maximum possible value of the input signal value In_R, and by setting the High side adjustment input value InH_R to 66 percent of the maximum possible value of the input signal value In_R, while the adjustment gain values were, respectively, Low side adjustment gain value $GainL_R=1.1$ and the High side adjustment gain value $GainH_R=0.9$.

[0057] As described above, according to the embodiment of the present invention, it is possible to update correction data in the LUTs **35**R, **35**G, **35**B for respective input signal values representing brightness levels of respective colors of red, green and blue in image data of an image to be displayed so as to correct the respective input signal values. Thus, it is possible to correct the input signal values based on the correction data in the LUTs **35**R, **35**G, **35**B, respectively, over the entire range of the input signal values representing brightness levels of the respective colors of red, green and blue in the image data of the image to be displayed. This makes it possible to increase color accuracy of the displayed image (i.e. to bring the color balance of the displayed image to a predetermined color balance) after the white balance adjustment is made, thereby increasing accuracy of the white balance adjustment.

[0058] Furthermore, according to the present embodiment, the white balance adjustment is made by recalculating and updating correction data in the LUTs **35**R, **35**G, **35**B, in which the recalculation and updating of the correction data in the LUTs **35**R, **35**G, **35**B can be performed in a short time, thereby making it possible to reduce time required for white balance adjustment. In addition, it is only required to change software in a conventional image display device without need to change the hardware structure of the image display device. Thus, it is possible to achieve the increase in the accuracy of white balance adjustment and reduce the time required for the white balance adjustment without increasing the cost of the image display device.

[0059] It is to be noted that the present invention is not limited to the above embodiment, and various modifications are possible within the spirit and scope of the present invention. For example, the signal processor **3** can be modified as follows. FIG. **5** is a schematic block diagram of a modified example of the image processor **3** with the microcomputer **11** in the LCD television **1**. As shown in FIG. **5**, the gain adjustment units **31**R, **31**G **31**B in the signal processor **3** shown in FIG. **2** can be replaced by offset adjustment units **41**R, **41**G, **41**B which serve to provide offset to the input signal values In_R, In_G, In_B representing brightness levels of respective colors of red, green and blue in the image data, or provide offset to the adjustment input values. The microcomputer **11** and the offset adjustment units **41**R, **41**G, **41**B form offset adjusting means according to the present invention, i.e. offset adjusting means for providing offset to an adjustment input value which is an input signal value representing a brightness level of each color of red, green and blue in image data of a white balance adjustment image to be used for recalculating the correction data in each LUT.

[0060] The offset adjustment unit **41**R comprises an adder circuit **43**R and an offset setting unit **44**R, and the offset adjustment unit **41**G comprises an adder circuit **43**G and an offset setting unit **34**G while the offset adjustment unit **41**B comprises an adder circuit **43**B and an offset setting unit **44**B. According to this modified example using the thus formed image processor **3**, when an image based on given image data (more specifically, an image based on a television signal or a white balance adjustment image) is displayed on the LCD panel **4**, the offset adjustment units **41**R, **41**B, **41**G provide offset to the input signal values In_R, In_G, In_B representing brightness levels of respective colors of red, green and blue in the image data of such image, or provide offset to the adjustment input values for white balance adjustment, as follows.

[0061] The adder circuit **43**R of the offset adjustment unit **41**R provides an offset to the input signal value In_R representing the brightness level of red by adding an offset value set in the offset setting unit **44**R to the input signal value In_R (input signal value In_R provided with an offset being hereafter referred to as offset-modified input signal value In_R") or to the adjustment input value for red. The adder circuit **43**G of the offset adjustment unit **41**G provides an offset to the input signal value In_G representing the brightness level of green by adding an offset value set in the offset setting unit **44**G to the input signal value In_G (input signal value In_G provided with an offset being hereafter referred to as offset-modified input signal value In_G") or to the adjustment input value for green. Similarly, the adder circuit **43**B of the offset adjustment unit **41**B provides an offset to the input signal value In_B representing the brightness level of blue by adding an offset value set in the offset setting unit **44**B to the input signal value In_B (input signal value In_B provided with an offset being hereafter referred to as offset-modified input signal value In_B") or to the adjustment input value for blue.

[0062] The offset-modified input signal values In_R", In_G", In_B" (i.e. the input signal values In_R, In_G, In_B provided with the offset by the offset adjustment units **41**R, **41**G, **41**B that are output signal values of the offset adjustment units **41**R, **41**G **41**B) are respectively input to the input value correction units **32**R, **32**G, **32**B, or the offset-modified adjustment input values are respectively input to the input value correction units **32**R, **32**G **32**B. The offset-modified input signal values In_R", In_G", In_B" or the offset-modified adjustment input values are then corrected based on correction data in the LUTs **35**R, **35**G **35**B, and an image based on the corrected input signal values (i.e. output signal values OUT_R', OUT_G', OUT_B') or a white balance adjustment image based on the corrected offset-modified adjustment input values is displayed on the LCD panel **4**.

[0063] Similarly as in the above embodiment, the microcomputer **11** in this modified example is designed to perform the steps of: determining an adjustment value to determine, as an adjustment offset value (adjustment value), an offset value of each of the offset adjustment units **41**R, **41**G, **41**B which value brings the color balance of the white balance adjustment image displayed on the LCD panel **4** to a predetermined color balance; recalculating an LUT correction data to recalculate the correction data in the LUTs **35**R, **35**G **35**B based on the correction data and the adjustment offset value; and updating an LUT correction data to update the correction data in the LUTs **35**R, **35**G, **35**B to the recalculated correction data.

[0064] In addition, an adjustment image according to the present invention is not limited to the one in the above embodiment, and can be another one. More specifically, although the adjustment image in the above embodiment comprises two adjustment images (Low and High), it can be a single adjustment image or three adjustment images so as to allow recalculation of correction data in the LUTs by using the single adjustment image or three adjustment images. Further, the color display unit to be used for displaying an image is not limited to an LCD panel, and may be a plasma display panel, a CRT display panel, an organic EL display panel, or the like. Similar functions and effects to those obtained by the LCD panel can be obtained by the plasma display panel, the CRT display panel, the organic EL display panel, or the like, making it possible to increase accuracy of white balance adjustment. Furthermore, the present invention can be applied not only to an LCD television, but to other image display devices including: an image display device to be connected to an AV (Audio Video) device such as a BD (Blue-Ray Disc) player; an image display device to be used for a personal computer; and an image display device of a video camera type to capture images and display the captured images on a color display.

[0065] The present invention has been described above using presently preferred embodiments, but such description should not be interpreted as limiting the present invention. Various modifications will become obvious, evident or apparent to those ordinarily skilled in the art, who have read the description. Accordingly, the appended claims should be interpreted to cover all modifications and alterations which fall within the spirit and scope of the present invention.

[0066] This application is based on Japanese patent application 2011-013348 filed Jan. 25, 2011, the content of which is hereby incorporated by reference.

1. An image display device comprising:

a color display unit for displaying a color image; and

an LUT which stores correction data for correcting color balance of the color image to be displayed on the color display unit,

wherein when a color image based on input image data is displayed on the color display unit, an input signal value representing a brightness level of each color of red, green and blue in the input image data is corrected based on the correction data in the LUT so as to display a color image based on the corrected input signal value on the color display unit, and

wherein the image display device further comprises:

LUT correction data recalculating means for recalculating the correction data in the LUT based on the correction data; and

LUT correction data updating means for updating the correction data in the LUT to the correction data recalculated by the LUT correction data recalculating means.

2. The image display device according to claim **1**,

which further comprises gain adjusting means for providing gain to an adjustment input value which is an input signal value representing a brightness level of each color of red, green and blue in image data of a white balance adjustment image to be used for recalculating the correction data in the LUT,

wherein when the adjustment image is displayed on the color display unit, the gain adjusting means provides a gain to the adjustment input value to generate a gain-modified adjustment input value, and the gain-modified adjustment input value is then corrected based on the correction data in the LUT so as to display a white balance adjustment image based on the corrected gain-modified input value,

wherein a gain value, which is provided to the adjustment input value by the gain adjusting means and which brings color balance of the white balance adjustment image displayed on the color display unit to a predetermined color balance, is determined as an adjustment gain value, and

wherein the LUT correction data recalculating means recalculates the correction data in the LUT based on the correction data and the adjustment gain value.

3. The image display device according to claim **2**,

wherein the white balance adjustment image comprises a plurality of different white balance adjustment images, and

wherein the LUT correction data recalculating means recalculates the correction data in the LUT based on the correction data and the adjustment gain values for the plurality of white balance adjustment images.

4. The image display device according to claim **3**,

wherein the correction data in the LUT represents a relationship between a pre-correction value representing a pre-correction brightness level of each color of red, green and blue and a post-correction value representing a brightness level to be output after correcting the pre-correction value,

wherein the number of the plurality of white balance adjustment images is two,

wherein assuming that x denotes the pre-correction value, y=F(x) denotes the post-correction value before recalculation by the LUT correction data recalculating means, and further y=G(x) denotes the post-correction value after recalculation by the LUT correction data recalculating means, the LUT correction data recalculating means recalculates the post-correction value y=G(x) in the LUT as:

$$y=G(x)=F(\mathrm{Gain}L\times x) \text{ in the range of } x\leqq InL;$$

$$y=G(x)=\alpha\times F(\mathrm{Gain}H\times x)+(1-\alpha)\times F(\mathrm{Gain}L\times x) \text{ in the range of } InL<x<InH; \text{ and}$$

$$y=G(x)=F(\mathrm{Gain}H\times x) \text{ in the range of } InH\leqq x$$

where InL denotes the adjustment input value in image data of a Low side white balance adjustment image which is one of the two white balance adjustment images with a lower brightness level while InH denotes the adjustment input value in image data of a High side white balance adjustment image which is the other of the two white balance adjustment images with a higher brightness level, and where GainL denotes the adjustment gain value which brings color balance of the Low side white balance adjustment image to a predetermined color balance while GainH denotes the adjustment gain value which brings color balance of the High side white balance adjustment image to a predetermined color balance, and further where a denotes the quotient of (x−GainL)/(GainH−GainL).

5. The image display device according to claim **1**,

which further comprises offset adjusting means for providing offset to an adjustment input value which is an input signal value representing a brightness level of each color of red, green and blue in image data of a white balance adjustment image to be used for recalculating the correction data in the LUT,

wherein when the adjustment image is displayed on the color display unit, the offset adjusting means provides an offset to the adjustment input value to generate an offset-modified adjustment input value, and the offset-modified adjustment input value is then corrected based on the correction data in the LUT so as to display a white balance adjustment image based on the corrected offset-modified input value,

wherein an offset value, which is provided to the adjustment input value by the offset adjusting means and which brings color balance of the white balance adjustment image displayed on the color display unit to a predetermined color balance, is determined as an adjustment offset value, and

wherein the LUT correction data recalculating means recalculates the correction data in the LUT based on the correction data and the adjustment offset value.

6. A method for adjusting correction data in an LUT which stores correction data for correcting color balance of a color image to be displayed on a color display unit, in which the correction data in the LUT represents a relationship between a pre-correction value representing a pre-correction brightness level of each color of red, green and blue and a post-correction value representing a brightness level to be output after correcting the pre-correction value, the method comprising the steps of:

displaying, on the color display unit, a white balance adjustment image to be used for adjusting the correction data in the LUT after using the correction data in the LUT to correct an adjustment input value which is an input signal value representing a brightness level of each color of red, green and blue in image data of the white balance adjustment image;

determining, as an adjustment gain value, a gain value to bring color balance of the white balance adjustment image displayed on the color display unit to a predetermined color balance after providing a gain to the adjustment input value and adjusting the gain so as to bring the color balance of the displayed white balance adjustment image to the predetermined color balance;

recalculating the correction data in the LUT based on the correction data and the adjustment gain value; and

updating the correction data in the LUT to the recalculated correction data.

7. A method for adjusting correction data in an LUT which stores correction data for correcting color balance of a color image to be displayed on a color display unit, in which the correction data in the LUT represents a relationship between a pre-correction value representing a pre-correction brightness level of each color of red, green and blue and a post-correction value representing a brightness level to be output after correcting the pre-correction value, the method comprising the steps of:

displaying, on the color display unit, a white balance adjustment image to be used for adjusting the correction data in the LUT after using the correction data in the LUT to correct an adjustment input value which is an input signal value representing a brightness level of each color of red, green and blue in image data of the white balance adjustment image;

determining, as an adjustment offset value, an offset value to bring color balance of the white balance adjustment image displayed on the color display unit to a predetermined color balance after providing an offset to the adjustment input value and adjusting the offset so as to bring the color balance of the displayed white balance adjustment image to the predetermined color balance;

recalculating the correction data in the LUT based on the correction data and the adjustment offset value; and

updating the correction data in the LUT to the recalculated correction data.

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