[0008]
A display control device according to one aspect of the present disclosure is to control an image display device provided with a backlight and a display panel, including an image processing device and a life controller, wherein

said image processing device includes:

a brightness correction unit to correct a brightness of an input image and output a corrected image;

a dimming rate calculator to calculate a dimming rate of said backlight based on said corrected image outputted from said brightness correction unit and said input image; and

a display history information generator to generate display history information based on the calculated dimming rate;

wherein

said image processing device causes said backlight to emit light with said dimming rate, and causes said display panel to display said corrected image;

said display history information is stored in a display history information storage, and includes accumulated display time, and

said service life controller controls a degree of the correction at said brightness correction unit based on the display history information, a service life at a time of commencement of use of said backlight, and a target service life of said backlight.

A display control device according to another aspect of the present disclosure is to control an image display device provided with a backlight and a display panel of a non-luminous type, including an image processing device and a life controller, wherein

said image processing device includes:

a brightness correction unit to correct a brightness of an input image and output a corrected image;

a corrected image luminance calculator to calculate an average luminance of the corrected image outputted from said brightness correction unit;

an input image luminance calculator to calculate an average luminance of said input image;

a dimming rate calculator to calculate a dimming rate of said backlight based on the average luminance of said corrected image and the average luminance of said input image;

a display history information generator to generate display history information based on the dimming rate calculated by said dimming rate calculator; and

a display history information storage to store the display history information generated by said display history information generator; wherein

said image processing device causes said backlight to emit light with said dimming rate, and causes said display panel to display said corrected image;

said display history information represents accumulated display time, from commencement of use of said image display device to a present time point, and an average value of the dimming rate during periods in which display was performed by said image display device, and

said service life controller controls a degree of the correction at said brightness correction unit based on the

gradation conversion curve TC shown in FIG. 8(f) by performing inverse normalization on the normalized gradation conversion curve T2(r) shown in FIG. 8(e). With regard to the gradation conversion curve TC shown in FIG. 8(f), the horizontal axis represents the input (pre-conversion) gradation value, and the vertical axis represents the output (post-conversion) gradation value.

The inverse normalization is performed such that 1 on the horizontal axis and 1 on the vertical axis in FIG. 8(e) are both converted to the maximum value of the gradation value, e.g., 255.

[0049]

The gradation converter 201c performs the gradation value conversion on the input image data Da, using the gradation conversion curve TC generated by the conversion curve generator 209, to generate the corrected image data Db.

The gradation conversion curve is generated for each frame, and the gradation conversion curve generated for each frame is used for the gradation conversion of the input image data Da of the particular frame. As in the gradation converter 201 in FIG. 2, or in the gradation converter ~~20c~~201c in FIG. ~~7~~5, the gradation conversion may be performed on the R component value, the G component value, and the B component value, or on the luminance component value.

[0050]

The conversion curve generator 209 may be of such a configuration that can change the form of the correction curve G(r) according to the control information Ce from the service life controller 4. Alternatively, the conversion curve generator 209 may be of such a configuration that stores a plurality of correction curves G(r), and selects one of the correction curves G(r), according to the control information Ce from the service life controller 4.

Writing or rewriting of information in the display history information storage 18 may be performed each time the information is generated by the display history information generator 17, or every constant period TLb, or when a predetermined event has happened, for example, when the power of the image display system is turned off. If it is performed every constant period TLb, the initial writing after the starting of the image processing device 3 may be performed immediately after the starting, or upon elapse of the constant period TLb from the starting.

[0069]

If the information generated by the display history information generator 17 is not written promptly in the display history information storage 18, the information is temporarily held within the display history information generator 17.

[0070]

The service life controller 4 performs service life control based on the display history information stored in the display history information storage 18, as well as a target service life TRGT, and a service life L_ORG at the time of the commencement of use of the backlight 7, internally stored in advance.

The service life control is performed, for example, by adjusting the degree of correction at the brightness correction unit 12. For the control over the brightness correction unit 12, the control information Ce is supplied. When the brightness correction unit 12 performs the adjustment of the degree of correction, the dimming rate calculator 15 also performs the adjustment of the degree of correction. The service life control may include the additional adjustment of the degree of correction at the dimming rate calculator ~~5~~15. Control information for control over the dimming rate calculator ~~5~~15 is denoted by Cf.

CLAIMS

~~[Claim 1]~~1. A display control device to control an image display device provided with a backlight and a display panel ~~of a non-luminous type~~, including an image processing device and a life controller, wherein

said image processing device includes:

a brightness correction unit to correct a brightness of an input image and output a corrected image;

~~a corrected image luminance calculator to calculate an average luminance of the corrected image outputted from said brightness correction unit;~~

~~an input image luminance calculator to calculate an average luminance of said input image;~~

a dimming rate calculator to calculate a dimming rate of said backlight based on ~~the average luminance of~~ said corrected image outputted from said brightness correction unit and ~~the average luminance of~~ said input image; and

a display history information generator to generate display history information based on the calculated dimming rate ~~calculated by said dimming rate calculator~~; ~~and~~

~~a display history information storage to store the display history information generated by said display history information generator;~~ wherein

said image processing device causes said backlight to emit light with said dimming rate, and causes said display panel to display said corrected image;

said display history information is stored in a display history information storage, and includes ~~represents~~ accumulated display time~~, from commencement of use of said image display device to a present time point, and an average value of the dimming rate during periods in which display was performed by said image display device~~, and

said service life controller controls a degree of the correction at said brightness correction unit based on the

display history information ~~stored in said display history information storage~~, a service life at a time of commencement of use of said backlight, and a target service life of said backlight.

~~[Claim 2]~~2. The display control device as set forth in claim 1, wherein

said service life controller includes:

a service life predictor to predict a remaining service life of said backlight based on said display history information stored in said display history information storage, and the service life at the time of commencement of use of said backlight; and

a correction degree adjuster to control the degree of the correction at said brightness correction unit, based on the remaining service life predicted by said service life predictor and said target service life.

~~[Claim 3]~~3. The display control device as set forth in claim 1 or 2, wherein

said service life controller also controls a degree of correction at said dimming rate calculator based on the display history information stored in said display history information storage, the service life at the time of commencement of use of said backlight, and the target service life of said backlight.

~~[Claim 4]~~4. The display control device as set forth in any of claims 1 to 3, wherein said brightness correction unit includes a gradation converter to convert gradation values of said input image.

~~[Claim 5]~~5. The display control device as set forth in claim 4, wherein

said input image has an R component value, a G component value, and a B component value for each pixel,

said brightness correction unit also includes:

a maximum component value calculator to calculate a maximum value among the R component value, the G component value, and the B component value for each pixel of said input image;

an intra-frame average value calculator to calculate an average value of the maximum values calculated by said maximum component value calculator, for each frame; and

a conversion curve selector to select a gradation conversion curve based on the intra-frame average value calculated by said intra-frame average value calculator; wherein

said gradation converter converts the values of said input image using the gradation conversion curve selected by said conversion curve selector.

~~[Claim 6]~~6. The display control device as set forth in claim 4, wherein

said input image has an R component value, a G component value, and a B component value for each pixel;

said brightness correction unit also includes:

a maximum component value calculator to calculate a maximum value among the R component value, the G component value, and the B component value for each pixel of said input image;

a histogram generator to generate a histogram of the maximum values calculated by said maximum component value calculator, for each frame; and

a conversion curve generator to generate a gradation conversion curve based on the histogram generated by said histogram generator; wherein

said gradation converter converts the values of said

input image using the gradation conversion curve generated by said conversion curve generator.

~~[Claim 7]~~7. The display control device as set forth in any of claims 1 to 3, wherein

said input image has an R component value, a G component value, and a B component value for each pixel; wherein

said brightness correction unit includes:

a maximum component value calculator to calculate a maximum value among the R component value, the G component value, and the B component value for each pixel of said input image;

an intra-frame maximum value calculator to calculate a maximum value among the maximum values, calculated by said maximum component value calculator, within each frame; and

a gain multiplier to determine a gain for each frame based on the maximum value calculated for the particular frame by said intra-frame maximum calculator, and multiply gradation values of said input image by the determined gain.

~~[Claim 8]~~8. The display control device as set forth in any of claims 1 to 7, wherein

said service life controller is configured to be separable from said image processing device.

9. A display control device to control an image display device provided with a backlight and a display panel of a non-luminous type, including an image processing device and a life controller, wherein

said image processing device includes:

a brightness correction unit to correct a brightness of an input image and output a corrected image;

a corrected image luminance calculator to calculate an average luminance of the corrected image outputted from said brightness correction unit;

an input image luminance calculator to calculate an average luminance of said input image;

a dimming rate calculator to calculate a dimming rate of said backlight based on the average luminance of said corrected image and the average luminance of said input image;

a display history information generator to generate display history information based on the dimming rate calculated by said dimming rate calculator; and

a display history information storage to store the display history information generated by said display history information generator; wherein

said image processing device causes said backlight to emit light with said dimming rate, and causes said display panel to display said corrected image;

said display history information represents accumulated display time, from commencement of use of said image display device to a present time point, and an average value of the dimming rate during periods in which display was performed by said image display device, and

said service life controller controls a degree of the correction at said brightness correction unit based on the display history information stored in said display history information storage, a service life at a time of commencement of use of said backlight, and a target service life of said backlight.

~~[Claim 9]~~10. An image display system including the display control device as set forth in any of claims 1 to ~~8~~9, and said image display device.

~~[Claim 10]~~11. A display control method for an image display device provided with a backlight and a display panel ~~of a non-luminous type~~, comprising:

correcting a brightness of an input image to output a

corrected image;

~~calculating an average luminance of said corrected image and an average luminance of said input image;~~

calculating a dimming rate of said backlight based on ~~the average luminance of~~ said corrected image and ~~the average luminance of~~ said input image;

generating display history information based on said dimming rate;

storing said display history information in a display history information storage; and

causing said backlight to emit light with said dimming rate and causing said corrected image to be displayed by said display panel; wherein

said display history information ~~represents~~ includes accumulated display time ~~from commencement of use~~ of said image display device, ~~up to a present time point, and an average value of the dimming rate during periods in which display is performed by said image display device,~~ and

a correction degree in the brightness correction is controlled based on the display history information ~~stored in said display history information storage,~~ a service life at a time of commencement of use of said backlight, and a target service life of said backlight.