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(54) Liquid crystal display apparatus

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Appareil d'affichage à cristaux liquides

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a liquid crystal display apparatus.

Description of the Related Art

[0002] U.S. Patent No. 6,727,872 discloses an image processing method for reducing a potential difference corresponding to a gradation level (or value) between black and white in the adjacent pixel so as to reduce disclination, which means a liquid crystal molecular orientation failure.

[0003] In order to restrain the disclination using the method disclosed in U.S. Patent No. 6,727,872 to a permissible level, an adjustment is required to gradually change potential differences of several to dozens of pixels on edges of an image and thus makes dull the edge of the image (or lowers the sharpness of the image). This problem is conspicuous in a liquid crystal display apparatus of a micro display type, such as a projection-type display apparatus, because its pixel size is small. In addition, there is a demand for preventing the discontinuous or uneven brightness in an image.

[0004] US 2008/0018630 A1 discloses a liquid crystal display device which includes: a liquid crystal display panel including a plurality of pixels for displaying images; and a drive means for driving the liquid crystal display panel while correcting pixel data of each pixel one after another, so that a voltage ratio between a voltage applied to one pixel and a voltage applied to its neighboring pixel is reduced. US 2002/0097207 A1 discloses a liquid crystal display (LCD) system comprising a matrix of pixels, wherein the system analyzes a video data stream for grayscale level jumps from extreme black to moderate gray levels, and where transitions in grayscale levels are restricted between adjacent pixels so as to reduce image degradation due to fringe field effects. And JP 2009-069608 A discloses a liquid crystal projector configured to reduce disclination in a liquid crystal by changing an upper limit output value according to average peak level (APL) of a display.

SUMMARY OF THE INVENTION

[0005] The prevent invention provides a liquid crystal display apparatus that can reduce disclination as well as restraining image quality deterioration.

[0006] The present invention in its first aspect provides a liquid crystal display apparatus as specified in claims 1 to 6, and a computer program as specified in claims 7 to 9.

[0007] Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

FIG. 1 is a perspective overview of a liquid crystal projector (liquid crystal display apparatus), to which the present invention is applicable.

FIG. 2 is a block diagram of the liquid crystal projector illustrated in FIG. 1.

FIG. 3 is a block diagram of a feature amount generator illustrated in FIG. 2.

FIGs. 4A-4C are views for explaining an operation of the feature amount generating circuit illustrated in FIG. 3.

FIGs. 5A and 5B are graphs for explaining a correction characteristic of a gradation value performed by a level corrector illustrated in FIG. 2.

FIG. 6 is a flowchart for explaining an operation of a CPU illustrated in FIG. 2 according to first, second, and third embodiments.

FIGs. 7A and 7B are correction value tables of S1103 illustrated in FIG. 6 according to the first, second, and third embodiments.

FIGs. 8A and 8B are views for explaining image processing according to the third embodiment.

FIG. 9 is a flowchart for explaining another operation of the CPU illustrated in FIG. 2 according to a fourth embodiment.

FIG. 10 is an explanatory view relating to a scan area when the feature amount generating circuit generates a feature amount.

FIG. 11 is a flowchart of generating a feature amount.

DESCRIPTION OF THE EMBODIMENTS

[0009] FIG. 1 is a perspective overview of a liquid crystal projector 100 (liquid crystal display apparatus) configured to display an input image signal using a liquid crystal display element, to which the present invention is applicable. An image signal output from a video player 2 is input into the liquid crystal projector 100 through a video cable 4. The liquid crystal projector 100 is an image projecting apparatus configured to project, as a projected image 8, light modulated by a liquid crystal display element, such as a liquid crystal panel, in accordance with an input image signal, onto a screen 6 (a surface to be projected).

[0010] FIG. 2 is a block diagram of the liquid crystal display apparatus 100. The liquid crystal display apparatus 100 includes an image processor 10, a feature amount generator 20, a CPU 30, a level corrector 40, a liquid crystal driver 50, and an optical system 60.

[0011] The image processor 10 performs processing for an input image signal, such as a brightness correction, a contrast correction, a gamma correction, and a chromatic conversion.

[0012] The feature amount generator 20 is connected to the image processor 10, and generates a feature amount that numerically represents an incidence state of a disclination in the image signal output from the image processor 10.

[0013] FIG. 3 is a block diagram of the feature amount generator 20. The feature amount generator 20 includes a delay circuit 22, a line memory 24, a feature amount generating circuit 26, and a random access memory ("RAM") 28.

[0014] The delay circuit 22 stores data of the input image signal into the line memory 24, delays it, and then reads it out. The line memory 24 stores data of the input image signal for maximum three horizontal lines. The delay circuit 22 reads gradation data for past two horizontal lines from the line memory 24, and inputs it into the feature amount generating circuit 26. The feature amount generating circuit 26 generates a feature amount, and stores it in the RAM 28. The feature amount stored in the RAM 28 contains information based on the number of pixel pairs that satisfy a correspondence relationship between a gradation value of a target pixel and a gradation value of a surrounding pixel around the target pixel. According to this embodiment, the feature amount is expressed in tables illustrated in FIGs. 4B and 4C.

[0015] Turning back to FIG. 2, the CPU 30 is connected to the feature amount generator 20 and the level corrector 40, and includes a memory (storage) (not illustrated) configured to store a correction value table illustrated in FIGs. 7A and 7B and a control method illustrated in FIG. 6, which will be described later. The CPU 30 is a microcomputer (processor) configured to read out a feature amount from the RAM 28 in the feature amount generator 20, to set the level correction amount (correction parameter) to the level corrector 40 in accordance with the feature amount, and to control a power or a condition of each component in the liquid crystal projector 100.

[0016] The level corrector 40 is connected to the feature amount generator 20 and the CPU 30. The level corrector 40 corrects a level in the image signal so as to reduce the disclination.

[0017] The liquid crystal driver 50 is connected to the level corrector 40, converts the image signal corrected by the level corrector 40 into a liquid crystal driving signal, and drives the liquid crystal display element 66 in the optical system 60.

[0018] The optical system 60 includes a lamp 62, an illumination optical system 64, a liquid crystal display element 66, and a projection optical system 68. The light emitted from the lamp 62 passes the illumination optical system 64, is modified by the liquid crystal display element 66, and is projected onto the screen 6 as the projected image 8 through the projection optical system (projection lens) 68. The liquid crystal display element 66 is connected to the liquid crystal driver 50, and modifies the incident light flux based on the liquid crystal driving signal from the liquid crystal driver 50.

FIRST EMBODIMENT

[0019] In the first embodiment, the CPU 30 commonly sets a disclination correcting amount to the overall image to the level corrector 40. FIG. 4A illustrates an arbitrary 3 x 3 pixel matrix in the image expressed by the image signal. FIG. 4B illustrates a table representative of a white-side feature amount (where "w" in Nw means white). FIG. 4C illustrates a table representative of a black-side feature amount (where "bk" in Nbk means black).

[0020] Since there are eight bits in this embodiment, a white's gradation level (gradation value) is 255, which corresponds to 8V. A black's gradation level is 0, which corresponds to 0V. The table representative of the white-side feature amount is a table used when the gradation value of the target pixel is close to 255. The table representative of the black-side feature amount is a table used when the gradation value of the target pixel is close to 0.

[0021] In the first embodiment, the feature amount generating circuit 26 compares the gradation value of the target pixel A illustrated in FIG. 4A with the gradation values of the surrounding pixels B_1 to B_8 around the target pixel A, and counts the number of feature amounts classified in matrices illustrated in FIGs. 4B and 4C.

[0022] There are eight surrounding pixels B_1 to B_8 in FIG. 4A, but one or more of pixels among these pixels B_1 to B_8 may be selected as a compared object according to the initial liquid crystal molecular orientation state and the driving mode. This embodiment sets two surrounding pixels B_2 and B_5 to the compared objects, and the feature amount is obtained by comparing the gradation values of these two surrounding pixels B_2 and B_5 with the gradation value of the target pixel.

[0023] FIG. 10 is an explanatory diagram relating to a scan area when the feature amount generator 20 generates a feature amount, and illustrates a relationship between a display area of the liquid crystal display element and a coordinate of the target pixel A. FIG. 10 illustrates the liquid crystal display element having a resolution comprised of H pixels in the horizontal direction and V pixels in the vertical direction. Herein, assume a coordinate system having an origin at the upper left corner pixel in the display area. The target pixel A is defined as a coordinate (Ax, Ay), which may be other than the outermost coordinates in the display area.

[0024] FIG. 11 illustrates an operational flow of the feature amount generator 20.

[0025] S1501 is started with a trigger of a signal in synchronization with a frame of each input image. A first target pixel is set as (Ax, Ay)=(1, 1) which is retreated inside by one pixel each from the upper left corner pixel in the image.

[0026] In S1502, the gradation of the target pixel A is compared with that of B_2.

[0027] In S1503, when the conditions illustrated in FIGs. 4B and 4C are met, values made by adding 1 to the feature amounts Nw_ij and Nbk_ij that satisfy the condition are written down in the RAM 28 (where each of i and j is a natural number selected from 1 to 5).

[0028] Similar to S1502 and S1503, the qualified feature amounts are added in S1504 and S1505 after the gradation of the target pixel A is compared with that of B_5.

[0029] In S1506 and S1507, whether processing from S1502 to S1506 has been performed for the overall area for which the feature amount is generated.

[0030] A description will now be given of a calculative example of a specific feature amount. For instance, when the gradation value of the target pixel A is 215, the position is the uppermost row position in FIG. 4B, and when the gradation value of the surrounding pixel B_2 is 185, the feature amount generating circuit 26 adds 1 to the value of Nw_11. The feature amount generating circuit 26 adds 1 to the value of Nw_11 when the gradation value of the surrounding pixel B_5 is 185. The feature amount generating circuit 26 adds 1 to the value of Nw_12 when the gradation value of the surrounding pixel B_5 is 195. Another uncounted element, such as Nw_13, remains 0 in FIGs. 4B and 4C since nothing is added to it.

[0031] Similarly, the feature amount generating circuit 26 sequentially sets the target pixel A to each of all pixels in the image, produces data illustrated in FIGs. 4B and 4C in superimposed (added) states, and generates a feature amount of the disclination in the image signal. In other words, the feature amount generating circuit 26 generates the number of pixel pairs that satisfy the correspondence in the table, and the feature amount in this embodiment represents a relationship among the gradation value of the target pixel A and the gradation value of the surrounding pixel and the number of surrounding pixels.

[0032] This embodiment adopts two types of tables: One type is a table (matrix) illustrated in FIG. 4B which represents a combination between the white gradation (gradation 255) or almost white gradation and the intermediate gradation of the adjacent pixel level. The other type is a conditional matrix illustrated in FIG. 4C which represents a combination between the black gradation (gradation 0) or almost black gradation and the intermediate gradation of the adjacent pixel level. However, the classification of the condition is not limited to this embodiment. For example, the number of rows and the number of columns in the conditional matrix may be increased or three types or more of conditional matrices may be used.

[0033] The level corrector 40 is a circuit having an input/output characteristic illustrated in FIG. 5A, and a blacks-side offset amount 701 and a white-side offset amount 702 are configured independently settable from the outside. The level corrector 40 reduces a dynamic range of the driving voltage of the liquid crystal display element 66. The abscissa axis in FIG. 5A denotes a gradation value of the input image, and its ordinate axis denotes a gradation value of the output image. The offset amounts 701 and 702 serve as correction amounts. The dynamic range is reduced by decreasing the maximum value of the driving voltage used to drive the liquid crystal or by increasing the minimum value or by the combination thereof. Reducing of the dynamic range of the driving voltage means reducing of the dynamic range of the gradation value in the input image signal.

[0034] FIG. 5B is a graph illustrating a relationship between an input gradation value and display brightness in the general liquid crystal display element, and nonlinear characteristics can be seen near white (with brightness of 1) and near black (with brightness of 0) in which the brightness variation ratio to the input gradation is very small. Since the brightness variation of the displayed image is small, the influence upon the displayed image by the reduced dynamic range of the driving voltage is little recognized even when the dynamic range of the driving voltage is reduced by the black-side offset amount 701 and the white-side offset amount 702. In the meanwhile, although FIG. 5B illustrates the offset amounts 701, 702 are about 130 and 50, this embodiment sets the offset amount 701 to about 5 and the offset amount 702 to about 7.

[0035] The set values of the reducing offset amounts 701, 702 of the dynamic range of the driving voltage may be set based on the characteristic representative of the relationship between the input gradation and the brightness of the liquid crystal display element so that the black-side offset amount 701 can be larger than the white-side offset amount 702. This configuration can restrain the brightness variation and more effectively reduce the disclination.

[0036] FIG. 6 is a flowchart for explaining an operation of the CPU 30 according to the first embodiment, and "S" stands for a step. The flowchart illustrated in FIG. 6 is implemented as a computer executable program.

[0037] In the initial state, both of the offset amounts 701, 702 are set to 0, and stored in the memory (not illustrated). In other words, the correction value at the initial state is 0 and, in this case, the characteristic illustrated in FIG. 5A is a diagonal line of Out=In.

[0038] The CPU 30 first sets x=1 and y=1 (S1101), and reads the feature amounts illustrated in FIGs. 4B and 4C from the RAM 28 (S1102). Next, the CPU 30 determines whether the value of the white-side feature amount (Nw_11) illustrated in FIG. 4B is larger than or equal to or smaller than a first threshold 10,000 (S1103).

[0039] When the CPU 30 determines that the number of white-side feature amounts (Nw_11) is larger than the threshold of 10,000, the CPU 30 obtains a reference value by referring to the correction value table illustrated in FIGs. 7A and 7B (S1104). FIG. 7A is a table for the white-side correction value corresponding to the offset amount 702 illustrated in FIGs. 5A and 5B, and FIG. 7B is a table for the black-side correction corresponding to the offset amount 701 illustrated in FIGs. 5A and 5B. Since the correction value (offset amount) corresponding to Nw_11 is 1, the CPU 30 obtains this as a reference value.

[0040] Next, the CPU 30 determines whether the reference value is larger than the current correction value (S1105), and if so replaces the current value (S1106). As discussed above, in the initial state, the correction value is 0, and the reference value of 1 is larger. Thus, the CPU 30 sets and stores in the memory (not illustrated) the reference value of 1 as a current correction value.

[0041] After NO of S1103, NO of S1105 or S1106, the CPU 30 determines whether there is another non-investigated combination of x and y (where x=1 to 5 and y=1 to 5) (S1107). When there is another x and y combination, x or y is incremented (S1108) and the flow returns to S1102.

[0042] For example, when the CPU 30 determines the white-side feature amount (Nw_12) is larger than the first threshold 10,000 (S1103), the CPU 30 refers to the correction table illustrated in FIG. 7A and obtains the reference value 2 corresponding to Nw_12 (S1104). Then, the CPU 30 determines whether the reference value 2 is larger than the current correction value 1 (S1105), and since it is larger than the current correction value 1, the CPU 30 replaces it with the correction value 2 (S1106).

[0043] When the CPU 30 determines that it has obtained feature amounts for all combinations of x and y (S1107), the CPU 30 determines the white-side offset amount 702 (S1109). Herein, the maximum correction value is set for all the combinations of x and y, and this becomes the white-side offset amount 702.

[0044] The CPU 30 performs a similar flow for the black-side feature amount (Nbk_xy) so to as determine the black-side correction amount, and determines the black-side offset amount 701 (S1110 to S1118). Finally, the CPU 30 sets the determined correction amounts (offset amounts 701, 702) to the level corrector 40 (S1119).

[0045] The conventional process sets the correction value only for an edge of an image in which the disclination occurs rather than for the entire image, and an image deterioration problem occurs, such as reduced sharpness.

[0046] On the other hand, in this embodiment, the CPU 30 performs processing for the entire image so as to set a correction value that reduces the dynamic range of the gradation value of the input image signal when the feature amount is larger than the first threshold, and so as not to set the correction value when the feature amount is equal to or smaller than the first threshold. Therefore, the image deterioration can be reduced.

[0047] This embodiment can display an image in which the disclination is reduced without discontinuing a gradation value at an edge of an image (therefore without damaging the sharpness). Of course, an area of the image processing may be set to a rectangular shape having one hundred pixels or more in one side.

[0048] The CPU 30 may performs weighing based on image correcting priority by differently setting the thresholds of S1103 and S1112 in accordance with feature amount indices x and y. In addition, while S1105 and S1114 adopt the maximum correction value, these values may be weighed in accordance with the feature amount indices x and y.

[0049] The feature amount generating circuit 26 generates the feature amount by counting the number of pixel pairs that satisfy the combination of the table illustrated in FIGs. 4B and 4C, the method of generating the feature amount is limited to this embodiment. For example, the feature amount may be set to a value of an evaluation function that uses, as a variable, the existence of the pixel that satisfies the combinational condition of the table illustrated in FIG. 4B or 4C.

SECOND EMBODIMENT

[0050] The second embodiment divides the image into a plurality of rectangular areas, and commonly sets the correction amount of the disclination to each area to the level corrector 40. While the second embodiment thus divides the display image into a plurality of areas, one side of each area may be 100 pixels or more so as to maintain the sharpness.

[0051] The apparatus structure applied to the second embodiment is similar to that illustrated in FIGs. 1 to 3 of the first embodiment. In addition, in the second embodiment, the feature amount illustrated in FIGs. 4B and 4C are generated for each area. The flow performed by CPU 30 is similar to that illustrated in FIG. 6. Nevertheless, the offset amounts 701, 702 set in S1109 and S1118 is the offset amount for the entire image in the first embodiment, whereas they are set for each area in the second embodiment.

[0052] This embodiment changes the dynamic range of the gradation value for each section having 100 pixels or more, and can display an image in which the sharpness is maintained to some extent and the disclination is reduced.

THIRD EMBODIMENT

[0053] The third embodiment is similar to the second embodiment in that the image is divided into a plurality of areas, each of which has 100 pixels in one side. However, in the second embodiment, the discontinuous brightness may occur at the boundary between an area in which the disclination is corrected and an area in which the disclination is not corrected. Therefore, the third embodiment is different from the second embodiment in that the third embodiment performs image processing so as to provide a smoothly continuous change of the brightness.

[0054] According to third embodiment, as illustrated in FIG. 8A, the displayed area is divided into a plurality of (16 x 10) areas, but the CPU 30 does not commonly set a disclination correcting amount to each area, to the level corrector 40.

[0055] The apparatus structure applied to the third embodiment is similar to that illustrated in FIGs. 1 to 3 in the first embodiment. In addition, in the third embodiment, the feature amount illustrated in FIGs. 4B and 4C is generated for each area. The flow performed by the CPU 30 is similar to that illustrated in FIG. 6. Nevertheless, in the first embodiment, the offset amounts 701 and 702 set in S1109 and S1118 are offset amounts for the entire image, whereas they are set for the central coordinate of each area in the third embodiment.

[0056] In other words, according to the third embodiment, the offset amount for the central coordinate of each area is set by the flow of illustrated in FIG. 6, and another offset of the coordinate is set as illustrated in FIG. 8B.

[0057] In FIG. 8B, 801a to 804a denote central coordinates of areas 801 to 804 illustrated in FIG. 8A. offset_a00 is a correction amount that contains information of the offset amounts 701, 702 set for the central coordinate 801a of the area 801 in the flow illustrated in FIG. 6. offset_a01 is a correction amount that contains information of the offset amounts 701, 702 set for the central coordinate 802a of the area 802 in the flow illustrated in FIG. 6. offset_a10 is a correction amount that contains information of the offset amounts 701, 702 set for the central coordinate 803a of the area 803 in the flow illustrated in FIG. 6. offset_all is a correction amount that contains information of the offset amounts 701, 702 set for the central coordinate 804a of the area 804 in the flow illustrated in FIG. 6.

[0058] At this time, an offset of an arbitrary coordinate (i,j) is found from the following expressions: When the offset amount is not a positive number, the CPU 30 of this embodiment converts the offset amount into a positive value by rounding. Next, the CPU 30 sets the offset amount obtained for each coordinate, to the level corrector 40:

Expression 1

$$\mathrm{offset\_h0} = \mathrm{offset\_a00} + \frac{i}{Di}(\mathrm{offset\_a01} - \mathrm{offset\_a00})$$

Expression 2

$$\mathrm{offset\_h1} = \mathrm{offset\_a10} + \frac{i}{Di}(\mathrm{offset\_a11} - \mathrm{offset\_a10})$$

Expression 3

$$\mathrm{offset\_ij} = \mathrm{offset\_h0} + \frac{j}{Dj}(\mathrm{offset\_ah1} - \mathrm{offset\_h1})$$

[0059] Herein, "i" denotes a distance in the horizontal direction and "j" denotes a distance in the vertical direction from a central coordinate of a certain area to a coordinate at an arbitrary position. Dx denotes a distance in the horizontal direction and Dy denotes a distance in the vertical direction between adjacent areas. offset_a** denotes a correction value of a central coordinate of a certain area. offset_h* denotes a value found through the interpolation calculation in the horizontal direction. offset_ij is a correction amount at an arbitrary coordinate determined by the interpolation calculation.

[0060] This embodiment also performs processing that sets a correction value for the entire image, and can display an image in which the disclination is reduced and the sharpness is maintained to some extent, instead of processing only for the edge of the image. In addition, this embodiment can obtain a natural image in which the level correction amount is smoothly connected through interpolations between the adjacent areas.

[0061] While this embodiment utilizes an interpolation operating means, another means may be used as long as an image generating means that does not cause the brightness discontinuity between areas. As a result of an investigation of the visual confirmation, the effect of this embodiment can be expected in the corrected image when the discontinuous brightness change generated associated with the image correction falls within 5% or 2% or 1% of the displayed maximum brightness.

FOURTH EMBODIMENT

[0062] The fourth embodiment is similar to the second and third embodiments in that the image is divided into a plurality of rectangular areas, each of which has one hundred pixels or more in one side. Even the image processing of the third embodiment may cause nonuniform brightness at the boundary between the area in which the disclination is corrected and the area in which the disclination is not corrected. Accordingly, the fourth embodiment performs image processing that corrects an area that does not require a correction of the disclination, so as to reduce the correctional difference from the area in which the disclination is corrected and to make the correctional difference unrecognized.

[0063] The apparatus structure applied to the fourth embodiment is similar to that illustrated in FIGs. 1 to 3 of the first embodiment. In addition, in the fourth embodiment, the feature amount illustrated in FIGs. 4B and 4C are generated for each area. The flow performed by CPU 30 is similar to that illustrated in FIG. 6. Nevertheless, the offset amounts 701, 702 set in S1109 and S1118 are the offset amounts set to the central coordinate of each area similar to the third embodiment.

[0064] In the fourth embodiment, similar to the third embodiment, the display image is divided into a plurality of areas, but the CPU 30 does not commonly set the disclination correcting amount to each area to the level corrector 40.

[0065] FIG. 9 is a flowchart for explaining an operation of the CPU 30 according to the fourth embodiment, and "S" stands for a step. The flowchart illustrated in FIG. 9 is implemented as a computer executable program.

[0066] Initially, similar to the third embodiment, the CPU 30 obtains an offset amount for the central coordinate of each area as described in the third embodiment using the flow illustrated in FIG. 6 (S1201). This embodiment is different from the third embodiment in that an obtained offset is a provisional offset amount in the fourth embodiment. In addition, the CPU 30 does not perform S1119 illustrated in FIG. 6.

[0067] Next, the CPU 30 searches the white-side offset amount 702 of the central coordinate of the entire area in the image for the maximum value and the minimum value (S1202), and determines whether a difference between the brightness corresponding to the maximum value and the brightness corresponding to the minimum value is larger than a second threshold 0.1 (10%) (S1203).

[0068] The second threshold of S1203 is not limited, and can be arbitrarily set. When the brightness difference between areas falls within 10%, 7%, or 5%, the uneven brightness is unlikely to stand out and the threshold in S1203 may be set so that the brightness difference cannot exceed one of the above values.

[0069] When determining that a difference between the maximum value and minimum value is larger than 10%, the CPU 30 modifies at least one of the maximum value and the minimum value because the correction amount difference between the areas is excessively large and the uneven brightness may be caused in the corrected image (S1204).

[0070] In case of No of S1203 or after S1204, the CPU 30 sets the offset amount to the level corrector 40 (S1205). S1205 corresponds to S1119. Thereafter, the offset amount at the coordinate other than the central coordinate of each area is set using Expressions 1 to 3 and the offset amount modified in S1204.

[0071] This embodiment performs processing that sets the correction value for the entire image instead of performing processing only for the edge of the image, and can also display an image in which the disclination is reduced and the sharpness is maintained to some extent. In addition, this embodiment can obtain a natural image in which the level correction amount is smoothly connected through interpolations between the adjacent areas. Moreover, this embodiment can provide a high-quality image with little uneven brightness.

[0072] This embodiment corrects the white-side offset amount 702 in which the uneven correction can be relatively visually recognized, but the black-side offset amount 701 may be similarly corrected.

[0073] While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments but defined by the following claims.

Claims

1. A liquid crystal display apparatus (100) configured to display an input image signal using a liquid crystal display element (66), comprising:

a feature amount generator (20) configured to generate (S1501-S1508) a feature amount based on gradation values of a plurality of pixels in an image represented by the input image signal;

a processor (30) adapted to set (S1119) a correction value (701, 702) when the feature amount is larger than a first threshold (S1103, S1112), and to not set the correction value when the feature amount is equal to or smaller than the first threshold;

a level corrector (40) adapted to correct a level of the input image signal based on the correction value (701, 702) by reducing a dynamic range of a gradation value of the input image signal when the correction value is set; and

a liquid crystal driver (50) configured to drive the liquid crystal display element based on the corrected input image signal;

characterized in that the feature amount generator (20) is configured to determine for the image the number (NW_ij) of pixel pairs therein for which the gradation values of the respective pixels satisfy a correspondence relationship (S1502, S1504) where each pixel pair is formed of a target pixel (A) and a surrounding pixel (B_2, B_5) around the target pixel, and the correspondence relationship includes an indication of the gradation value for the target pixel (A) being the black gradation or almost black gradation and the gradation value for the surrounding pixel (B_2, B_5) being an intermediate gradation, or the gradation value for the target pixel (A) being the white gradation or almost white gradation and the gradation value for the surrounding pixel (B_2, B_5) being an intermediate gradation; and to generate the feature amount as feature amount for the overall image based on the determined number of pixel pairs; and

the processor (30) is adapted to set the correction value for the overall image in correspondence to the feature amount for the image.

2. The apparatus according to claim 1,

wherein the feature amount generator (20) is configured to generate the feature amount for the overall image by sequentially setting the target pixel (A) to each pixel in the image.

3. A liquid crystal display apparatus (100) configured to display an input image signal using a liquid crystal display element (66), comprising:

a feature amount generator (20) configured to generate (S1501-S1508) a feature amount based on gradation values of a plurality of pixels in an image represented by the input image signal;

a processor (30) adapted to set (S1119) a correction value (701, 702) when the feature amount is larger than a first threshold (S1103, S1112), and to not set the correction value when the feature amount is equal to or smaller than the first threshold;

a level corrector (40) adapted to correct a level of the input image signal based on the correction value (701, 702) by reducing a dynamic range of a gradation value of the input image signal when the correction value is set; and

a liquid crystal driver (50) configured to drive the liquid crystal display element based on the corrected input image signal;

characterized in that the apparatus is configured to divide the image into a plurality of rectangular areas (801-804) each including 100 pixels or more on one side;

the feature amount generator (20) is configured to determine for each rectangular area (801-804) the number (NW_ij) of pixel pairs therein for which the gradation values of the respective pixels satisfy a correspondence relationship (S1502, S1504), where each pixel pair is formed of a target pixel (A) and a surrounding pixel (B_2, B_5) around the target pixel, and the correspondence relationship includes an indication of the gradation value for the target pixel (A) being the black gradation or almost black gradation and the gradation value for the surrounding pixel (B_2, B_5) being an intermediate gradation, or the gradation value for the target pixel (A) being the white gradation or almost white gradation and the gradation value for the surrounding pixel (B_2, B_5) being an intermediate gradation; and to generate the feature amount as feature amount for each overall rectangular area based on the determined number of pixel pairs for said rectangular area; and

the processor (30) is adapted to set the correction value for each overall rectangular area in correspondence to the feature amount for said rectangular area.

4. A liquid crystal display apparatus (100) configured to display an input image signal using a liquid crystal display element (66), comprising:

a feature amount generator (20) configured to generate (S1501-S1508) a feature amount based on gradation values of a plurality of pixels in an image represented by the input image signal;

a processor (30) adapted to set (S1119) a correction value (701, 702) based on the feature amount;
a level corrector (40) adapted to correct a level of the input image signal based on the correction value by reducing a dynamic range of a gradation value of the input image signal; and
a liquid crystal driver (50) configured to drive the liquid crystal display element based on the corrected input image signal;
characterized in that the apparatus is configured to divide the image into a plurality of rectangular areas (801-804) each including 100 pixels or more on one side;
the feature amount generator (20) is configured to determine for each rectangular area (801-804) the number (NW_ij) of pixel pairs therein for which the gradation values of the respective pixels satisfy a correspondence relationship (S1502, S1504), where each pixel pair is formed of a target pixel (A) and a surrounding pixel (B_2, B_5) around the target pixel, and the correspondence relationship includes an indication of the gradation value for the target pixel (A) being the black gradation or almost black gradation and the gradation value for the surrounding pixel (B_2, B_5) being an intermediate gradation, or the gradation value for the target pixel (A) being the white gradation or almost white gradation and the gradation value for the surrounding pixel (B_2, B_5) being an intermediate gradation; and to generate the feature amount as feature amount for each overall rectangular area based on the determined number of pixel pairs for said rectangular area; and
the processor (30) is adapted to set (S1205) the correction value (offset_a00 - offset_a11) for a central coordinate (801a - 804a) of each rectangular area in correspondence to the feature amount for said rectangular area, and to set the correction value (offset_ij) for coordinates ((i,j)) other than the central coordinates of the rectangular areas through an interpolation of the correction values for the central coordinates of adjacent rectangular areas.

5. The apparatus according to claim 4,

wherein the processor (30) is adapted to set (S1205) the correction values of the central coordinates so that a difference between a maximum and a minimum value of the white-side correction values (702) of the central coordinates or of the black-side correction values (701) of the central coordinates becomes smaller than a second threshold (S1203, S1204).

6. The apparatus according to any one of claims 3 to 5,

wherein the feature amount generator (20) is configured to generate the feature amount for each overall rectangular area by sequentially setting the target pixel (A) to each pixel in said rectangular area.

7. A computer program for causing a liquid crystal display apparatus (100) to display an input image signal using a liquid crystal display element (66), the computer program being adapted to perform the steps of:

generating (S1501-S1508) a feature amount based on gradation values of a plurality of pixels in an image represented by the input image signal;
setting (S1119) a correction value (701, 702) when the feature amount is larger than a first threshold (S1103, S1112), and not setting the correction value when the feature amount is equal to or smaller than the first threshold;
correcting a level of the input image signal based on the correction value (701, 702) by reducing a dynamic range of a gradation value of the input image signal when the correction value is set; and
driving the liquid crystal display element based on the corrected input image signal;
characterized in that the step of generating the feature amount determines for the image the number (NW_ij) of pixel pairs therein for which the gradation values of the respective pixels satisfy a correspondence relationship (S1502, S1504), where each pixel pair is formed of a target pixel (A) and a surrounding pixel (B_2, B_5) around the target pixel, and the correspondence relationship includes an indication of the gradation value for the target pixel (A) being the black gradation or almost black gradation and the gradation value for the surrounding pixel (B_2, B_5) being an intermediate gradation, or the gradation value for the target pixel (A) being the white gradation or almost white gradation and the gradation value for the surrounding pixel (B_2, B_5) being an intermediate gradation; and generates the feature amount as feature amount for the overall image based on the determined number of pixel pairs; and
the step of setting the correction value sets the correction value for the overall image in correspondence to the feature amount for the image.

8. A computer program for causing a liquid crystal display apparatus (100) to display an input image signal using a liquid crystal display element (66), the computer program being adapted to perform the steps of:

generating (S1501-S1508) a feature amount based on gradation values of a plurality of pixels in an image represented by the input image signal;
setting (S1119) a correction value (701, 702) when the feature amount is larger than a first threshold (S1103, S1112), and not setting the correction value when the feature amount is equal to or smaller than the first threshold;
correcting a level of the input image signal based on the correction value (701, 702) by reducing a dynamic range of a gradation value of the input image signal when the correction value is set; and
driving the liquid crystal display element based on the corrected input image signal;
characterized in that the computer program is further adapted to divide the image into a plurality of rectangular areas (801-804) each including 100 pixels or more on one side;
the step of generating the feature amount determines for each rectangular area (801-804) the number (NW_ij) of pixel pairs therein for which the gradation values of the respective pixels satisfy a correspondence relationship (S1502, S1504), where each pixel pair is formed of a target pixel (A) and a surrounding pixel (B_2, B_5) around the target pixel, and the correspondence relationship includes an indication of the gradation value for the target pixel (A) being the black gradation or almost black gradation and the gradation value for the surrounding pixel (B_2, B_5) being an intermediate gradation, or the gradation value for the target pixel (A) being the white gradation or almost white gradation and the gradation value for the surrounding pixel (B_2, B_5) being an intermediate gradation; and generates the feature amount as feature amount for each overall rectangular area based on the determined number of pixel pairs for said rectangular area; and
the step of setting the correction value sets the correction value for each overall rectangular area in correspondence to the feature amount for said rectangular area.

9. A computer program for causing a liquid crystal display apparatus (100) to display an input image signal using a liquid crystal display element (66), the computer program being adapted to perform the steps of:

generating (S1501-S1508) a feature amount based on gradation values of a plurality of pixels in an image represented by the input image signal;
setting (S1119) a correction value (701, 702) based on the feature amount;
correcting a level of the input image signal based on the correction value by reducing a dynamic range of a gradation value of the input image signal; and
driving the liquid crystal display element based on the corrected input image signal;
characterized in that the computer program is further adapted to divide the image into a plurality of rectangular areas (801-804) each including 100 pixels or more on one side;
the step of generating the feature amount determines for each rectangular area (801-804) the number (NW_ij) of pixel pairs therein for which the gradation values of the respective pixels satisfy a correspondence relationship (S1502, S1504), where each pixel pair is formed of a target pixel (A) and a surrounding pixel (B_2, B_5) around the target pixel, and the correspondence relationship includes an indication of the gradation value for the target pixel (A) being the black gradation or almost black gradation and the gradation value for the surrounding pixel (B_2, B_5) being an intermediate gradation, or the gradation value for the target pixel (A) being the white gradation or almost white gradation and the gradation value for the surrounding pixel (B_2, B_5) being an intermediate gradation; and generates the feature amount as feature amount for each overall rectangular area based on the determined number of pixel pairs for said rectangular area; and
the step of setting the correction value sets the correction value (offset_a00 - offset_a11) for a central coordinate (801a - 804a) of each rectangular area in correspondence to the feature amount for said rectangular area, and sets the correction value (offset_ij) for coordinates ((i,j)) other than the central coordinates of the rectangular areas through an interpolation of the correction values for the central coordinates of adjacent rectangular areas.

Patentansprüche

1. Flüssigkristallanzeigevorrichtung (100), die konfiguriert ist, ein Eingangsbildsignal unter Verwendung eines Flüssigkristallanzeigeelements (66) anzuzeigen, umfassend:

einen Merkmalsbetragsgenerator (20), der konfiguriert ist, einen Merkmalsbetrag basierend auf Gradationswerten von mehreren Pixeln in einem durch das Eingangsbildsignal dargestellten Bild zu generieren (S1501 - S1508);
eine Verarbeitungseinrichtung (30), die dafür ausgelegt ist, einen Korrekturwert (701, 702) einzustellen (S1119), wenn der Merkmalsbetrag größer als ein erster Schwellenwert (S1103, S1112) ist, und den Korrekturwert nicht einzustellen, wenn der Merkmalsbetrag kleiner oder gleich dem ersten Schwellenwert ist;

einen Pegelkorrektor (40), der dafür ausgelegt ist, einen Pegel des Eingangsbildsignals basierend auf dem Korrekturwert (701, 702) durch Verringern eines Dynamikbereichs eines Gradationswerts des Eingangsbildsignals zu korrigieren, wenn der Korrekturwert eingestellt ist; sowie
einen Flüssigkristalltreiber (50), der konfiguriert ist, das Flüssigkristallanzeigeelement basierend auf dem korrigierten Eingangsbildsignal anzutreiben;
dadurch gekennzeichnet, dass der Merkmalsbetragsgenerator (20) konfiguriert ist, für das Bild die Anzahl (NW_ij) Pixelpaare darin zu bestimmen, für welche die Gradationswerte der jeweiligen Pixel eine Entsprechungsbeziehung (S1502, S1504) erfüllen, wobei jedes Pixelpaar aus einem Zielpixel (A) und einem Umgebungspixel (B_2, B_5) in der Nähe des Zielpixels gebildet ist, und die Entsprechungsbeziehung eine Angabe beinhaltet, dass der Gradationswert für das Zielpixel (A) die schwarze Gradation oder fast schwarze Gradation und der Gradationswert für das Umgebungspixel (B_2, B_5) eine mittlere Gradation ist, oder der Gradationswert für das Zielpixel (A) die weiße Gradation oder fast weiße Gradation und der Gradationswert für das Umgebungspixel (B_2, B_5) eine mittlere Gradation ist; und den Merkmalsbetrag als Merkmalsbetrag für das gesamte Bild basierend auf der bestimmten Anzahl Pixelpaare zu generieren; sowie
dass die Verarbeitungseinrichtung (30) dafür ausgelegt ist, den Korrekturwert für das gesamte Bild in Entsprechung zum Merkmalsbetrag für das Bild einzustellen.

2. Vorrichtung nach Anspruch 1, wobei der Merkmalsbetragsgenerator (20) konfiguriert ist, den Merkmalsbetrag für das gesamte Bild durch sequentielles Einstellen des Zielpixels (A) auf jedes Pixel im Bild zu generieren.

3. Flüssigkristallanzeigevorrichtung (100), die konfiguriert ist, ein Eingangsbildsignal unter Verwendung eines Flüssigkristallanzeigeelements (66) anzuzeigen, umfassend:

einen Merkmalsbetragsgenerator (20), der konfiguriert ist, einen Merkmalsbetrag basierend auf Gradationswerten von mehreren Pixeln in einem durch das Eingangsbildsignal dargestellten Bild zu generieren (S1501 - S1508);
eine Verarbeitungseinrichtung (30), die dafür ausgelegt ist, einen Korrekturwert (701, 702) einzustellen (S1119), wenn der Merkmalsbetrag größer als ein erster Schwellenwert (S1103, S1112) ist, und den Korrekturwert nicht einzustellen, wenn der Merkmalsbetrag kleiner oder gleich dem ersten Schwellenwert ist;
einen Pegelkorrektor (40), der dafür ausgelegt ist, einen Pegel des Eingangsbildsignals basierend auf dem Korrekturwert (701, 702) durch Verringern eines Dynamikbereichs eines Gradationswerts des Eingangsbildsignals zu korrigieren, wenn der Korrekturwert eingestellt ist; sowie
einen Flüssigkristalltreiber (50), der konfiguriert ist, das Flüssigkristallanzeigeelement basierend auf dem korrigierten Eingangsbildsignal anzutreiben;
dadurch gekennzeichnet, dass die Vorrichtung konfiguriert ist, das Bild in mehrere rechteckige Gebiete (801-804) zu unterteilen, die jeweils 100 oder mehr Pixel auf einer Seite beinhalten;
dass der Merkmalsbetragsgenerator (20) konfiguriert ist, für jedes rechteckige Gebiet (801-804) die Anzahl (NW_ij) Pixelpaare darin zu bestimmen, für welche die Gradationswerte der jeweiligen Pixel eine Entsprechungsbeziehung (S1502, S1504) erfüllen, wobei jedes Pixelpaar aus einem Zielpixel (A) und einem Umgebungspixel (B_2, B_5) in der Nähe des Zielpixels gebildet ist, und die Entsprechungsbeziehung eine Angabe beinhaltet, dass der Gradationswert für das Zielpixel (A) die schwarze Gradation oder fast schwarze Gradation und der Gradationswert für das Umgebungspixel (B_2, B_5) eine mittlere Gradation ist, oder der Gradationswert für das Zielpixel (A) die weiße Gradation oder fast weiße Gradation und der Gradationswert für das Umgebungspixel (B_2, B_5) eine mittlere Gradation ist; und den Merkmalsbetrag als Merkmalsbetrag für jedes gesamte rechteckige Gebiet basierend auf der bestimmten Anzahl Pixelpaare für dieses rechteckige Gebiet zu generieren; sowie
dass die Verarbeitungseinrichtung (30) dafür ausgelegt ist, den Korrekturwert für jedes gesamte rechteckige Gebiet in Entsprechung zum Merkmalsbetrag für dieses rechteckige Gebiet einzustellen.

4. Flüssigkristallanzeigevorrichtung (100), die konfiguriert ist, ein Eingangsbildsignal unter Verwendung eines Flüssigkristallanzeigeelements (66) anzuzeigen, umfassend:

einen Merkmalsbetragsgenerator (20), der konfiguriert ist, einen Merkmalsbetrag basierend auf Gradationswerten von mehreren Pixeln in einem durch das Eingangsbildsignal dargestellten Bild zu generieren (S1501 - S 1508);
eine Verarbeitungseinrichtung (30), die dafür ausgelegt ist, einen Korrekturwert (701, 702) basierend auf dem Merkmalsbetrag einzustellen (S1119);
einen Pegelkorrektor (40), der dafür ausgelegt ist, einen Pegel des Eingangsbildsignals basierend auf dem

Korrekturwert durch Verringern eines Dynamikbereichs eines Gradationswerts des Eingangsbildsignals zu korrigieren; sowie
einen Flüssigkristalltreiber (50), der konfiguriert ist, das Flüssigkristallanzeigeelement basierend auf dem korrigierten Eingangsbildsignal anzutreiben;
dadurch gekennzeichnet, dass die Vorrichtung konfiguriert ist, das Bild in mehrere rechteckige Gebiete (801-804) zu unterteilen, die jeweils 100 oder mehr Pixel auf einer Seite beinhalten;
dass der Merkmalsbetragsgenerator (20) konfiguriert ist, für jedes rechteckige Gebiet (801-804) die Anzahl (NW_ij) Pixelpaare darin zu bestimmen, für welche die Gradationswerte der jeweiligen Pixel eine Entsprechungsbeziehung (S1502, S1504) erfüllen, wobei jedes Pixelpaar aus einem Zielpixel (A) und einem Umgebungspixel (B_2, B_5) in der Nähe des Zielpixels gebildet ist, und die Entsprechungsbeziehung eine Angabe beinhaltet, dass der Gradationswert für das Zielpixel (A) die schwarze Gradation oder fast schwarze Gradation und der Gradationswert für das Umgebungspixel (B_2, B_5) eine mittlere Gradation ist, oder der Gradationswert für das Zielpixel (A) die weiße Gradation oder fast weiße Gradation und der Gradationswert für das Umgebungspixel (B_2, B_5) eine mittlere Gradation ist; und den Merkmalsbetrag als Merkmalsbetrag für jedes gesamte rechteckige Gebiet basierend auf der bestimmten Anzahl Pixelpaare für dieses rechteckige Gebiet zu generieren; sowie
dass die Verarbeitungseinrichtung (30) dafür ausgelegt ist, den Korrekturwert (offset_a00 - offset_a11) für eine zentrale Koordinate (801a - 804a) jedes rechteckigen Gebiets in Entsprechung zum Merkmalsbetrag für dieses rechteckige Gebiet einzustellen (S1205), und
den Korrekturwert (offset_ij) für andere Koordinaten ((i,j)) als die zentralen Koordinaten der rechteckigen Gebiete durch eine Interpolation der Korrekturwerte für die zentralen Koordinaten von benachbarten rechteckigen Gebieten einzustellen.

5. Vorrichtung nach Anspruch 4, wobei die Verarbeitungseinrichtung (30) dafür ausgelegt ist, die Korrekturwerte der zentralen Koordinaten so einzustellen (S1205), dass ein Unterschied zwischen einem Maximal- und einem Minimalwert der weißseitigen Korrekturwerte (702) der zentralen Koordinaten oder der schwarzseitigen Korrekturwerte (701) der zentralen Koordinaten kleiner als ein zweiter Schwellenwert (S1203, S1204) wird.

6. Vorrichtung nach einem der Ansprüche 3 bis 5, wobei der Merkmalsbetragsgenerator (20) konfiguriert ist, den Merkmalsbetrag für jedes gesamte rechteckige Gebiet durch sequentielles Einstellen des Zielpixels (A) auf jedes Pixel in diesem rechteckigen Gebiet zu generieren.

7. Computerprogramm zum Veranlassen, dass eine Flüssigkristallanzeigevorrichtung (100) ein Eingangsbildsignal unter Verwendung eines Flüssigkristallanzeigeelements (66) anzeigt, wobei das Computerprogramm dafür ausgelegt ist, die folgenden Schritte durchzuführen:

Generieren (S1501 - S1508) eines Merkmalsbetrags basierend auf Gradationswerten von mehreren Pixeln in einem durch das Eingangsbildsignal dargestellten Bild;
Einstellen (S1119) eines Korrekturwerts (701, 702), wenn der Merkmalsbetrag größer als ein erster Schwellenwert (S1103, S1112) ist, und nicht Einstellen des Korrekturwerts, wenn der Merkmalsbetrag kleiner oder gleich dem ersten Schwellenwert ist;
Korrigieren eines Pegels des Eingangsbildsignals basierend auf dem Korrekturwert (701, 702) durch Verringern eines Dynamikbereichs eines Gradationswerts des Eingangsbildsignals, wenn der Korrekturwert eingestellt ist; sowie
Antreiben des Flüssigkristallanzeigeelements basierend auf dem korrigierten Eingangsbildsignal;
dadurch gekennzeichnet, dass der Schritt zum Generieren des Merkmalsbetrags für das Bild die Anzahl (NW_ij) Pixelpaare darin bestimmt, für welche die Gradationswerte der jeweiligen Pixel eine Entsprechungsbeziehung (S1502, S1504) erfüllen, wobei jedes Pixelpaar aus einem Zielpixel (A) und einem Umgebungspixel (B_2, B_5) in der Nähe des Zielpixels gebildet ist, und die Entsprechungsbeziehung eine Angabe beinhaltet, dass der Gradationswert für das Zielpixel (A) die schwarze Gradation oder fast schwarze Gradation und der Gradationswert für das Umgebungspixel (B_2, B_5) eine mittlere Gradation ist, oder der Gradationswert für das Zielpixel (A) die weiße Gradation oder fast weiße Gradation und der Gradationswert für das Umgebungspixel (B_2, B_5) eine mittlere Gradation ist; und den Merkmalsbetrag als Merkmalsbetrag für das gesamte Bild basierend auf der bestimmten Anzahl Pixelpaare generiert; sowie
dass der Schritt zum Einstellen des Korrekturwerts den Korrekturwert für das gesamte Bild in Entsprechung zum Merkmalsbetrag für das Bild einstellt.

8. Computerprogramm zum Veranlassen, dass eine Flüssigkristallanzeigevorrichtung (100) ein Eingangsbildsignal

unter Verwendung eines Flüssigkristallanzeigeelements (66) anzeigt, wobei das Computerprogramm dafür ausgelegt ist, die folgenden Schritte durchzuführen:

Generieren (S1501 - S1508) eines Merkmalsbetrags basierend auf Gradationswerten von mehreren Pixeln in einem durch das Eingangsbildsignal dargestellten Bild;
Einstellen (S1119) eines Korrekturwerts (701, 702), wenn der Merkmalsbetrag größer als ein erster Schwellenwert (S1103, S1112) ist, und nicht Einstellen des Korrekturwerts, wenn der Merkmalsbetrag kleiner oder gleich dem ersten Schwellenwert ist;
Korrigieren eines Pegels des Eingangsbildsignals basierend auf dem Korrekturwert (701, 702) durch Verringern eines Dynamikbereichs eines Gradationswerts des Eingangsbildsignals, wenn der Korrekturwert eingestellt ist; sowie
Antreiben des Flüssigkristallanzeigeelements basierend auf dem korrigierten Eingangsbildsignal;
dadurch gekennzeichnet, dass das Computerprogramm weiterhin dafür ausgelegt ist, das Bild in mehrere rechteckige Gebiete (801-804) zu unterteilen, die jeweils 100 oder mehr Pixel auf einer Seite beinhalten;
dass der Schritt zum Generieren des Merkmalsbetrags für jedes rechteckige Gebiet (801-804) die Anzahl (NW_ij) Pixelpaare darin bestimmt, für welche die Gradationswerte der jeweiligen Pixel eine Entsprechungsbeziehung (S1502, S1504) erfüllen, wobei jedes Pixelpaar aus einem Zielpixel (A) und einem Umgebungspixel (B_2, B_5) in der Nähe des Zielpixels gebildet ist, und die Entsprechungsbeziehung eine Angabe beinhaltet, dass der Gradationswert für das Zielpixel (A) die schwarze Gradation oder fast schwarze Gradation und der Gradationswert für das Umgebungspixel (B_2, B_5) eine mittlere Gradation ist, oder der Gradationswert für das Zielpixel (A) die weiße Gradation oder fast weiße Gradation und der Gradationswert für das Umgebungspixel (B_2, B_5) eine mittlere Gradation ist; und den Merkmalsbetrag als Merkmalsbetrag für jedes gesamte rechteckige Gebiet basierend auf der bestimmten Anzahl Pixelpaare für dieses rechteckige Gebiet generiert; sowie
dass der Schritt zum Einstellen des Korrekturwerts den Korrekturwert für jedes gesamte rechteckige Gebiet in Entsprechung zum Merkmalsbetrag für dieses rechteckige Gebiet einstellt.

9. Computerprogramm zum Veranlassen, dass eine Flüssigkristallanzeigevorrichtung (100) ein Eingangsbildsignal unter Verwendung eines Flüssigkristallanzeigeelements (66) anzeigt, wobei das Computerprogramm dafür ausgelegt ist, die folgenden Schritte durchzuführen:

Generieren (S1501 - S1508) eines Merkmalsbetrags basierend auf Gradationswerten von mehreren Pixeln in einem durch das Eingangsbildsignal dargestellten Bild;
Einstellen (S1119) eines Korrekturwerts (701, 702) basierend auf dem Merkmalsbetrag;
Korrigieren eines Pegels des Eingangsbildsignals basierend auf dem Korrekturwert durch Verringern eines Dynamikbereichs eines Gradationswerts des Eingangsbildsignals; sowie
Antreiben des Flüssigkristallanzeigeelements basierend auf dem korrigierten Eingangsbildsignal;
dadurch gekennzeichnet, dass das Computerprogramm weiterhin dafür ausgelegt ist, das Bild in mehrere rechteckige Gebiete (801-804) zu unterteilen, die jeweils 100 oder mehr Pixel auf einer Seite beinhalten;
dass der Schritt zum Generieren des Merkmalsbetrags für jedes rechteckige Gebiet (801-804) die Anzahl (NW_ij) Pixelpaare darin bestimmt, für welche die Gradationswerte der jeweiligen Pixel eine Entsprechungsbeziehung (S1502, S1504) erfüllen, wobei jedes Pixelpaar aus einem Zielpixel (A) und einem Umgebungspixel (B_2, B_5) in der Nähe des Zielpixels gebildet ist, und die Entsprechungsbeziehung eine Angabe beinhaltet, dass der Gradationswert für das Zielpixel (A) die schwarze Gradation oder fast schwarze Gradation und der Gradationswert für das Umgebungspixel (B_2, B_5) eine mittlere Gradation ist, oder der Gradationswert für das Zielpixel (A) die weiße Gradation oder fast weiße Gradation und der Gradationswert für das Umgebungspixel (B_2, B_5) eine mittlere Gradation ist; und den Merkmalsbetrag als Merkmalsbetrag für jedes gesamte rechteckige Gebiet basierend auf der bestimmten Anzahl Pixelpaare für dieses rechteckige Gebiet generiert; sowie
dass der Schritt zum Einstellen des Korrekturwerts den Korrekturwert (offset_a00 - offset_a11) für eine zentrale Koordinate (801a - 804a) jedes rechteckigen Gebiets in Entsprechung zum Merkmalsbetrag für dieses rechteckige Gebiet einstellt, und
den Korrekturwert (offset_ij) für andere Koordinaten ((i,j)) als die zentralen Koordinaten der rechteckigen Gebiete durch eine Interpolation der Korrekturwerte für die zentralen Koordinaten von benachbarten rechteckigen Gebieten einstellt.

Revendications

1. Appareil d’affichage à cristaux liquides (100), configuré pour afficher un signal d’image d’entrée à l’aide d’un élément d'affichage à cristaux liquides (66), comprenant :

un générateur de valeur de propriété (20) configuré pour produire (S1501 à S1508) une valeur de propriété en fonction de valeurs de gradation d'une pluralité de pixels dans une image représentée par le signal d'image d'entrée ;
un processeur (30) conçu pour armer (S1119) une valeur de correction (701, 702) quand la valeur de propriété est supérieure à un premier seuil (S1103, S1112) et ne pas armer la valeur de correction lorsque la valeur de propriété est inférieure ou égale au premier seuil ;
un correcteur de niveau (40) conçu pour corriger un niveau du signal d'image d'entrée en fonction de la valeur de correction (701, 702) en réduisant la plage dynamique d'une valeur de gradation du signal d'image d'entrée quand la valeur de correction est armée ; et
un pilote de cristaux liquides (50) configuré pour commander l'élément d'affichage à cristaux liquides en fonction du signal d'image d'entrée corrigé ;
caractérisé en ce que le générateur de valeur de propriété (20) est configuré pour déterminer sur l'image le nombre (NW_ij) de paires de pixels qui y sont contenues et pour lesquelles les valeurs de gradation des pixels respectifs satisfont une relation de correspondance (S1502, S1504), où chaque paire de pixels est formée d'un pixel cible (A) et d'un pixel adjacent (B_2, B_5) autour du pixel cible, où la relation de correspondance inclut une indication de la valeur de gradation pour le pixel cible (A), qui est la gradation noire ou la gradation presque noire, et la valeur de gradation pour le pixel adjacent (B_2, B_5), qui est une gradation intermédiaire, ou bien où la valeur de gradation pour le pixel cible (A) est la gradation blanche ou la gradation presque blanche et la valeur de gradation pour le pixel adjacent (B_2, B_5) est une gradation intermédiaire ; et pour produire la valeur de propriété sous la forme d'une valeur de propriété pour l'image dans son ensemble, en fonction du nombre déterminé de paires de pixels ; et
le processeur (30) est conçu pour armer la valeur de correction de l'image dans son ensemble en fonction de la valeur de propriété de l'image.

2. Appareil selon la revendication 1, dans lequel le générateur de valeur de propriété (20) est configuré pour produire la valeur de propriété de l'image dans son ensemble en paramétrant séquentiellement le pixel cible (A) pour chaque pixel de l'image.

3. Appareil d'affichage à cristaux liquides (100), configuré pour afficher un signal d'image d'entrée à l'aide d'un élément d'affichage à cristaux liquides (66), comprenant :

un générateur de valeur de propriété (20) configuré pour produire (S1501 à S1508) une valeur de propriété en fonction de valeurs de gradation d'une pluralité de pixels dans une image représentée par le signal d'image d'entrée ;
un processeur (30) conçu pour armer (S1119) une valeur de correction (701, 702) quand la valeur de propriété est supérieure à un premier seuil (S1103, S1112) et ne pas armer la valeur de correction lorsque la valeur de propriété est inférieure ou égale au premier seuil ;
un correcteur de niveau (40) conçu pour corriger un niveau du signal d'image d'entrée en fonction de la valeur de correction (701, 702) en réduisant la plage dynamique d'une valeur de gradation du signal d'image d'entrée quand la valeur de correction est armée ; et
un pilote de cristaux liquides (50) configuré pour commander l'élément d'affichage à cristaux liquides en fonction du signal d'image d'entrée corrigé ;
caractérisé en ce que l'appareil est configuré pour diviser l'image en une pluralité de régions rectangulaires (801 à 804), chacune comprenant 100 pixels ou plus sur un côté ;
le générateur de valeur de propriété (20) est configuré pour déterminer, pour chacune des régions rectangulaires (801 à 804), le nombre (NW_ij) de paires de pixels qui y sont contenues et pour lesquelles les valeurs de gradation des pixels respectifs satisfont une relation de correspondance (S1502, S1504), où chaque paire de pixels est formée d'un pixel cible (A) et d'un pixel adjacent (B_2, B_5) autour du pixel cible, où la relation de correspondance inclut une indication de la valeur de gradation pour le pixel cible (A), qui est la gradation noire ou la gradation presque noire, et la valeur de gradation pour le pixel adjacent (B_2, B_5), qui est une gradation intermédiaire, ou bien où la valeur de gradation pour le pixel cible (A) est la gradation blanche ou la gradation presque blanche et la valeur de gradation pour le pixel adjacent (B_2, B_5) est une gradation intermédiaire ; et pour produire la valeur de propriété sous la forme d'une valeur de propriété pour chaque région rectangulaire, en fonction du nombre déterminé de paires de pixels dans ladite région rectangulaire ; et
le processeur (30) est conçu pour armer la valeur de correction de chaque région rectangulaire en fonction de la valeur de propriété pour ladite région rectangulaire.

4. Appareil d'affichage à cristaux liquides (100), configuré pour afficher un signal d'image d'entrée à l'aide d'un élément d'affichage à cristaux liquides (66), comprenant :

un générateur de valeur de propriété (20) configuré pour produire (S1501 à S1508) une valeur de propriété en fonction de valeurs de gradation d'une pluralité de pixels dans une image représentée par le signal d'image d'entrée ;
un processeur (30) conçu pour armer (S1119) une valeur de correction (701, 702) en fonction de la valeur de propriété ;
un correcteur de niveau (40) conçu pour corriger un niveau du signal d'image d'entrée en fonction de la valeur de correction, en réduisant la plage dynamique d'une valeur de gradation du signal d'image d'entrée ; et
un pilote de cristaux liquides (50) configuré pour commander l'élément d'affichage à cristaux liquides en fonction du signal d'image d'entrée corrigé ;
caractérisé en ce que l'appareil est configuré pour diviser l'image en une pluralité de régions rectangulaires (801 à 804), chacune comprenant 100 pixels ou plus sur un côté ;
le générateur de valeur de propriété (20) est configuré pour déterminer, pour chacune des régions rectangulaires (801 à 804), le nombre (NW_ij) de paires de pixels qui y sont contenues et pour lesquelles les valeurs de gradation des pixels respectifs satisfont une relation de correspondance (S1502, S1504), où chaque paire de pixels est formée d'un pixel cible (A) et d'un pixel adjacent (B_2, B_5) autour du pixel cible, où la relation de correspondance inclut une indication de la valeur de gradation pour le pixel cible (A), qui est la gradation noire ou la gradation presque noire, et la valeur de gradation pour le pixel adjacent (B_2, B_5), qui est une gradation intermédiaire, ou bien où la valeur de gradation pour le pixel cible (A) est la gradation blanche ou la gradation presque blanche et la valeur de gradation pour le pixel adjacent (B_2, B_5) est une gradation intermédiaire ; et pour produire la valeur de propriété sous la forme d'une valeur de propriété pour chaque région rectangulaire, en fonction du nombre déterminé de paires de pixels dans ladite région rectangulaire ; et
le processeur (30) est conçu pour armer (S1205) la valeur de correction (offset_a00 - offset_a11) pour une coordonnée centrale (801a à 804a) de chaque région rectangulaire en fonction de la valeur de propriété pour ladite région rectangulaire ; et
pour armer la valeur de correction (offset_ij) pour des coordonnées ((i, j)) autres que les coordonnées centrales de chaque région rectangulaire grâce à une interpolation des valeurs de correction pour les coordonnées centrales de régions rectangulaires adjacentes.

5. Appareil selon la revendication 4, dans lequel le processeur (30) est conçu pour armer (S1205) les valeurs de correction des coordonnées centrales de manière qu'une différence entre une valeur maximale et minimale des valeurs de correction du côté blanc (702) des coordonnées centrales ou des valeurs de correction du côté noir (701) des coordonnées centrales soit inférieure à un second seuil (S1203, S1204).

6. Appareil selon l'une quelconque des revendications 3 à 5, dans lequel le générateur de valeur de propriété (20) est configuré pour produire la valeur de propriété pour chaque région rectangulaire en paramétrant séquentiellement le pixel cible (A) pour chaque pixel dans ladite région rectangulaire.

7. Programme d'ordinateur destiné à commander à un appareil d'affichage à cristaux liquides (100) d'afficher un signal d'image d'entrée à l'aide d'un élément d'affichage à cristaux liquides (66), le programme d'ordinateur étant conçu pour exécuter les étapes consistant à :

produire (S1501 à S1508) une valeur de propriété en fonction de valeurs de gradation d'une pluralité de pixels dans une image représentée par le signal d'image d'entrée ;
armer (S1119) une valeur de correction (701, 702) quand la valeur de propriété est supérieure à un premier seuil (S1103, S1112) et ne pas armer la valeur de correction lorsque la valeur de propriété est inférieure ou égale au premier seuil ;
corriger un niveau du signal d'image d'entrée en fonction de la valeur de correction (701, 702) en réduisant la plage dynamique d'une valeur de gradation du signal d'image d'entrée quand la valeur de correction est armée ; et
commander l'élément d'affichage à cristaux liquides en fonction du signal d'image d'entrée corrigé ;
caractérisé en ce que l'étape de production de la valeur de propriété détermine sur l'image le nombre (NW_ij) de paires de pixels qui y sont contenues et pour lesquelles les valeurs de gradation des pixels respectifs satisfont une relation de correspondance (S1502, S1504), où chaque paire de pixels est formée d'un pixel cible (A) et d'un pixel adjacent (B_2, B_5) autour du pixel cible, où la relation de correspondance inclut une indication de la valeur de gradation pour le pixel cible (A), qui est la gradation noire ou la gradation presque noire, et la valeur

de gradation pour le pixel adjacent (B_2, B_5), qui est une gradation intermédiaire, ou bien où la valeur de gradation pour le pixel cible (A) est la gradation blanche ou la gradation presque blanche et la valeur de gradation pour le pixel adjacent (B_2, B_5) est une gradation intermédiaire ; et pour produire la valeur de propriété sous la forme d'une valeur de propriété pour l'image dans son ensemble, en fonction du nombre déterminé de paires de pixels ; et
l'étape d'armement de la valeur de correction arme la valeur de correction de l'image dans son ensemble en fonction de la valeur de propriété de l'image.

8. Programme d'ordinateur destiné à commander à un appareil d'affichage à cristaux liquides (100) d'afficher un signal d'image d'entrée à l'aide d'un élément d'affichage à cristaux liquides (66), le programme d'ordinateur étant conçu pour exécuter les étapes consistant à :

produire (S1501 à S1508) une valeur de propriété en fonction de valeurs de gradation d'une pluralité de pixels dans une image représentée par le signal d'image d'entrée ;
armer (S1119) une valeur de correction (701, 702) quand la valeur de propriété est supérieure à un premier seuil (S1103, S1112) et ne pas armer la valeur de correction lorsque la valeur de propriété est inférieure ou égale au premier seuil ;
corriger un niveau du signal d'image d'entrée en fonction de la valeur de correction (701, 702) en réduisant la plage dynamique d'une valeur de gradation du signal d'image d'entrée quand la valeur de correction est armée ; et
commander l'élément d'affichage à cristaux liquides en fonction du signal d'image d'entrée corrigé ;
caractérisé en ce que le programme d'ordinateur est en outre conçu pour diviser l'image en une pluralité de régions rectangulaires (801 à 804), chacune comprenant 100 pixels ou plus sur un côté ;
l'étape de production de la valeur de propriété détermine, pour chacune des régions rectangulaires (801 à 804), le nombre (NW_ij) de paires de pixels qui y sont contenues et pour lesquelles les valeurs de gradation des pixels respectifs satisfont une relation de correspondance (S1502, S1504), où chaque paire de pixels est formée d'un pixel cible (A) et d'un pixel adjacent (B_2, B_5) autour du pixel cible, où la relation de correspondance inclut une indication de la valeur de gradation pour le pixel cible (A), qui est la gradation noire ou la gradation presque noire, et la valeur de gradation pour le pixel adjacent (B_2, B_5), qui est une gradation intermédiaire, ou bien où la valeur de gradation pour le pixel cible (A) est la gradation blanche ou la gradation presque blanche et la valeur de gradation pour le pixel adjacent (B_2, B_5) est une gradation intermédiaire ; et pour produire la valeur de propriété sous la forme d'une valeur de propriété pour chaque région rectangulaire, en fonction du nombre déterminé de paires de pixels dans ladite région rectangulaire ; et
l'étape d'armement de la valeur de correction arme la valeur de correction de chaque région rectangulaire dans son ensemble en fonction de la valeur de propriété de ladite région rectangulaire.

9. Programme d'ordinateur destiné à commander à un appareil d'affichage à cristaux liquides (100) d'afficher un signal d'image d'entrée à l'aide d'un élément d'affichage à cristaux liquides (66), le programme d'ordinateur étant conçu pour exécuter les étapes consistant à :

produire (S1501 à S1508) une valeur de propriété en fonction de valeurs de gradation d'une pluralité de pixels dans une image représentée par le signal d'image d'entrée ;
armer (S1119) une valeur de correction (701, 702) en fonction de la valeur de propriété ;
corriger un niveau du signal d'image d'entrée en fonction de la valeur de correction, en réduisant la plage dynamique d'une valeur de gradation du signal d'image d'entrée ; et
commander l'élément d'affichage à cristaux liquides en fonction du signal d'image d'entrée corrigé ;
caractérisé en ce que le programme d'ordinateur est en outre conçu pour diviser l'image en une pluralité de régions rectangulaires (801 à 804), chacune comprenant 100 pixels ou plus sur un côté ;
l'étape de production de la valeur de propriété détermine, pour chacune des régions rectangulaires (801 à 804), le nombre (NW_ij) de paires de pixels qui y sont contenues et pour lesquelles les valeurs de gradation des pixels respectifs satisfont une relation de correspondance (S1502, S1504), où chaque paire de pixels est formée d'un pixel cible (A) et d'un pixel adjacent (B_2, B_5) autour du pixel cible, où la relation de correspondance inclut une indication de la valeur de gradation pour le pixel cible (A), qui est la gradation noire ou la gradation presque noire, et la valeur de gradation pour le pixel adjacent (B_2, B_5), qui est une gradation intermédiaire, ou bien où la valeur de gradation pour le pixel cible (A) est la gradation blanche ou la gradation presque blanche et la valeur de gradation pour le pixel adjacent (B_2, B_5) est une gradation intermédiaire ; et pour produire la valeur de propriété sous la forme d'une valeur de propriété pour chaque région rectangulaire, en fonction du nombre déterminé de paires de pixels dans ladite région rectangulaire ; et

l'étape d'armement de la valeur de correction arme (S1205) la valeur de correction (offset_a00 - offset_a11) pour une coordonnée centrale (801a à 804a) de chaque région rectangulaire en fonction de la valeur de propriété pour ladite région rectangulaire ; et
arme la valeur de correction (offset_ij) pour des coordonnées ((i, j)) autres que les coordonnées centrales de chaque région rectangulaire grâce à une interpolation des valeurs de correction des coordonnées centrales de régions rectangulaires adjacentes.

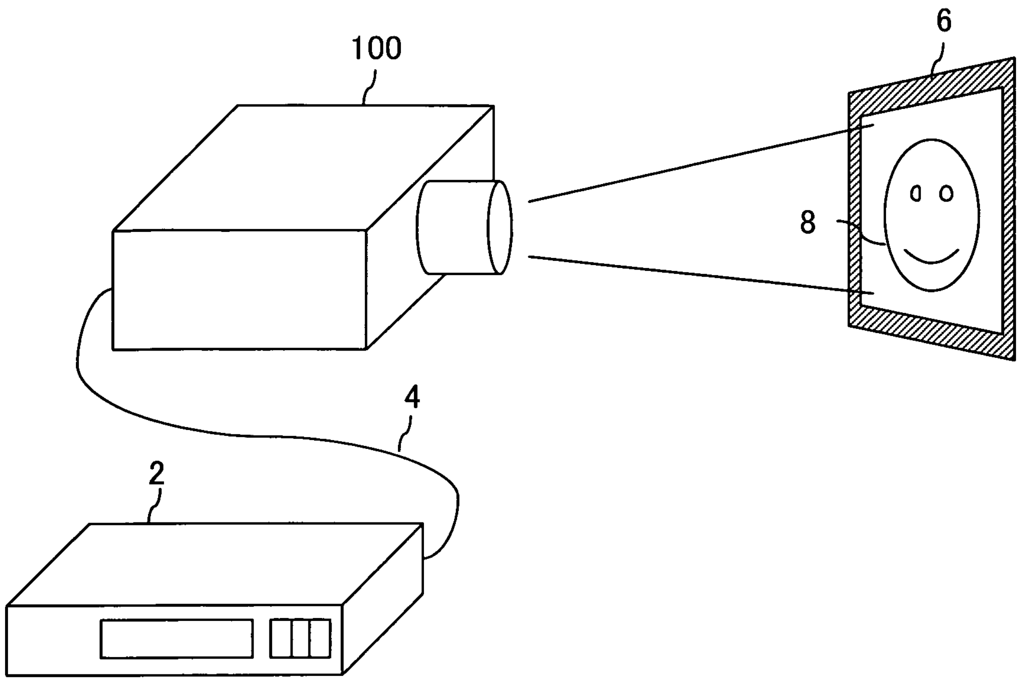
100
6
8
4
2

FIG. 1

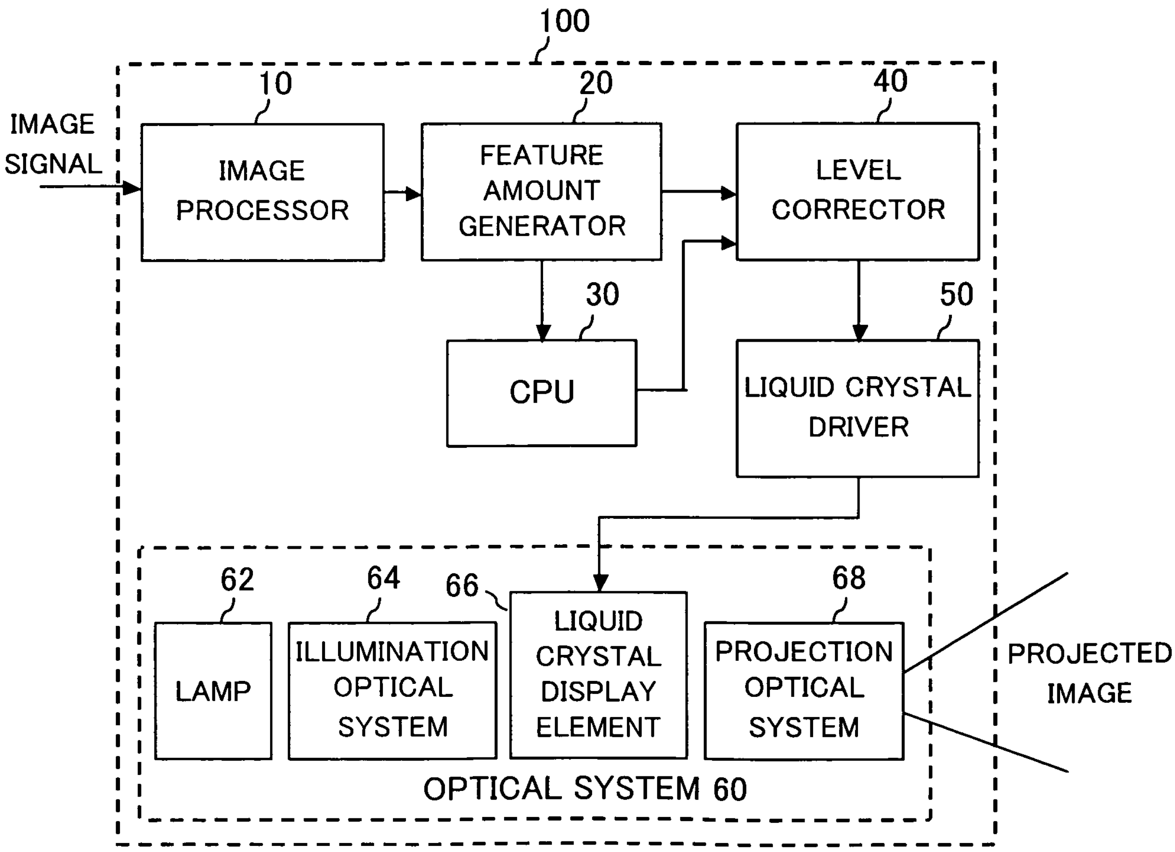
100
IMAGE SIGNAL
10
IMAGE PROCESSOR
20
FEATURE AMOUNT GENERATOR
40
LEVEL CORRECTOR
30
CPU
50
LIQUID CRYSTAL DRIVER
62
LAMP
64
ILLUMINATION OPTICAL SYSTEM
66
LIQUID CRYSTAL DISPLAY ELEMENT
68
PROJECTION OPTICAL SYSTEM
PROJECTED IMAGE
OPTICAL SYSTEM 60

FIG. 2

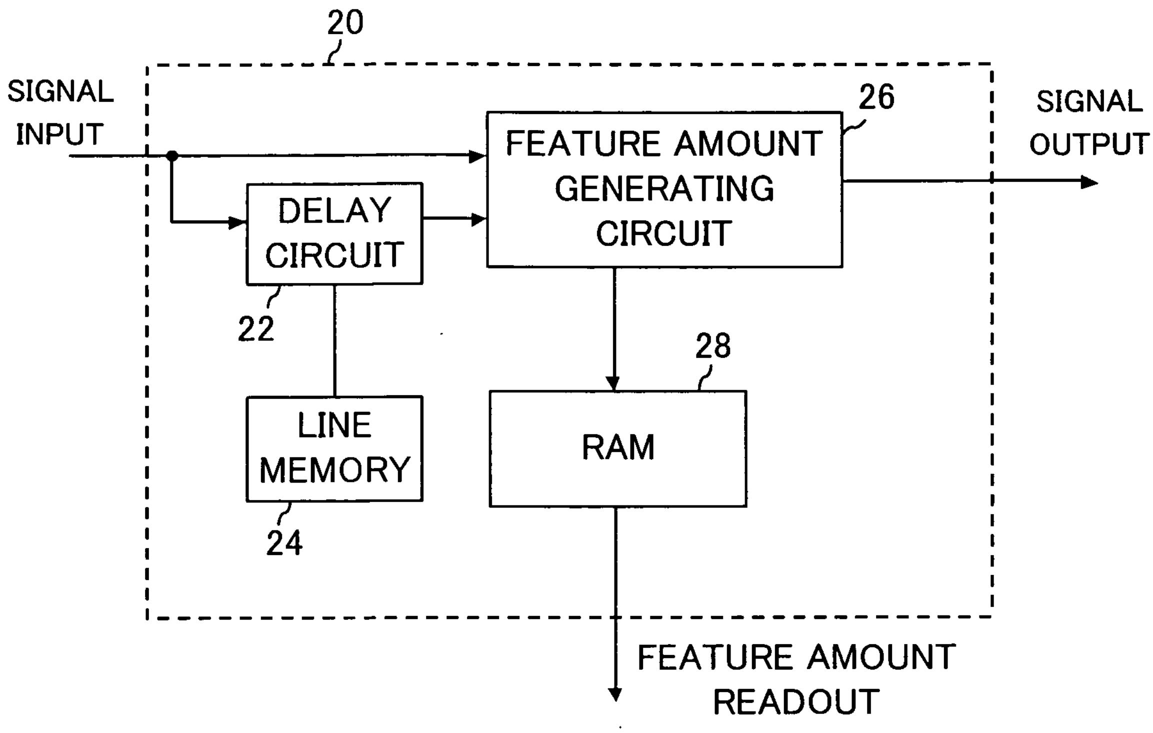
20
SIGNAL INPUT
26
FEATURE AMOUNT GENERATING CIRCUIT
SIGNAL OUTPUT
DELAY CIRCUIT
22
28
LINE MEMORY
RAM
24
FEATURE AMOUNT READOUT

FIG. 3

B_1	B_2	B_3
B_4	A	B_5
B_6	B_7	B_8

FIG. 4A

		ADJACENT PIXEL LEVEL (8bit)				
		180<B≦190	190<B≦200	200<B≦210	210<B≦220	220<B≦230
TARGET PIXEL LEVEL (8bit)	210<A≦220	Nw_11	Nw_12	Nw_13	Nw_14	Nw_15
	220<A≦230	Nw_21	Nw_22	Nw_23	Nw_24	Nw_25
	230<A≦240	Nw_31	Nw_32	Nw_33	Nw_34	Nw_35
	240<A≦250	Nw_41	Nw_42	Nw_43	Nw_44	Nw_45
	250<A≦255	Nw_51	Nw_52	Nw_53	Nw_54	Nw_55

FIG. 4B

		ADJACENT PIXEL LEVEL (8bit)				
		0<B≦10	10<B≦50	50<B≦100	100<B≦180	180<B≦255
TARGET PIXEL LEVEL (8bit)	0<A≦1	Nbk_11	Nbk_12	Nbk_13	Nbk_14	Nbk_15
	1<A≦2	Nbk_21	Nbk_22	Nbk_23	Nbk_24	Nbk_25
	2<A≦3	Nbk_31	Nbk_32	Nbk_33	Nbk_34	Nbk_35
	3<A≦4	Nbk_41	Nbk_42	Nbk_43	Nbk_44	Nbk_45
	4<A≦5	Nbk_51	Nbk_52	Nbk_53	Nbk_54	Nbk_55

FIG. 4C

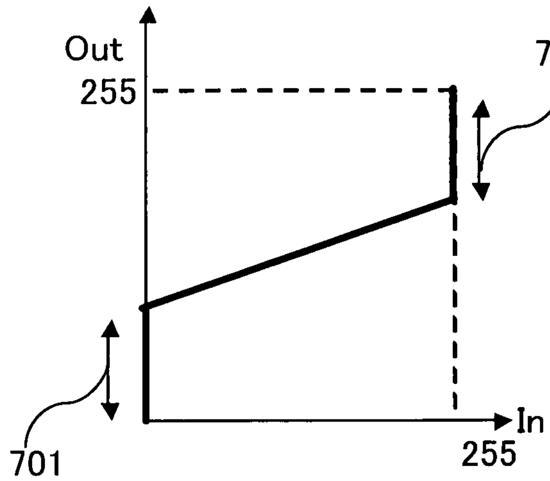
Out
255
702
701
In
255

FIG. 5A

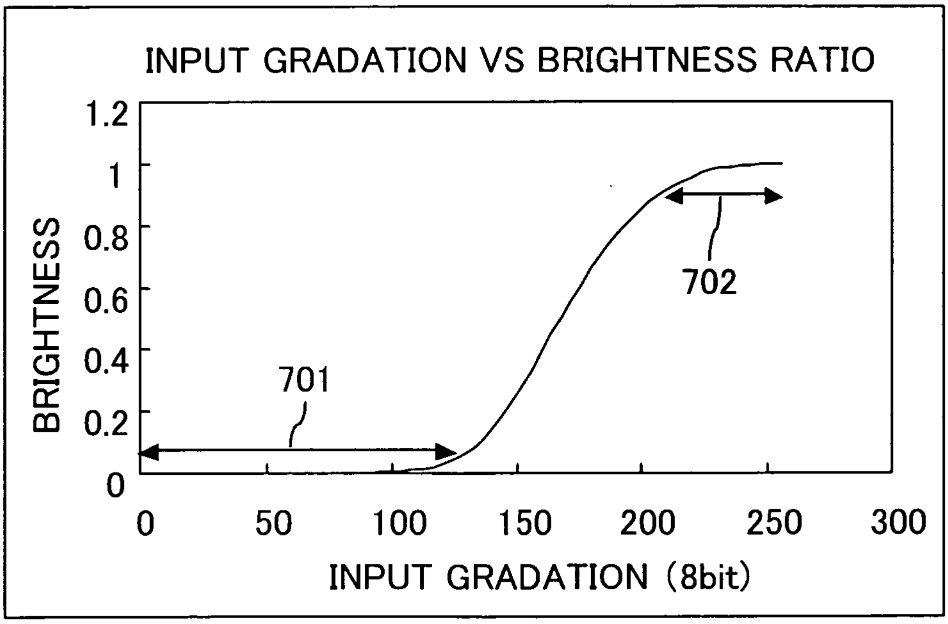
INPUT GRADATION VS BRIGHTNESS RATIO
BRIGHTNESS
1.2
1
0.8
0.6
0.4
0.2
0
701
702
0
50
100
150
200
250
300
INPUT GRADATION (8bit)

FIG. 5B

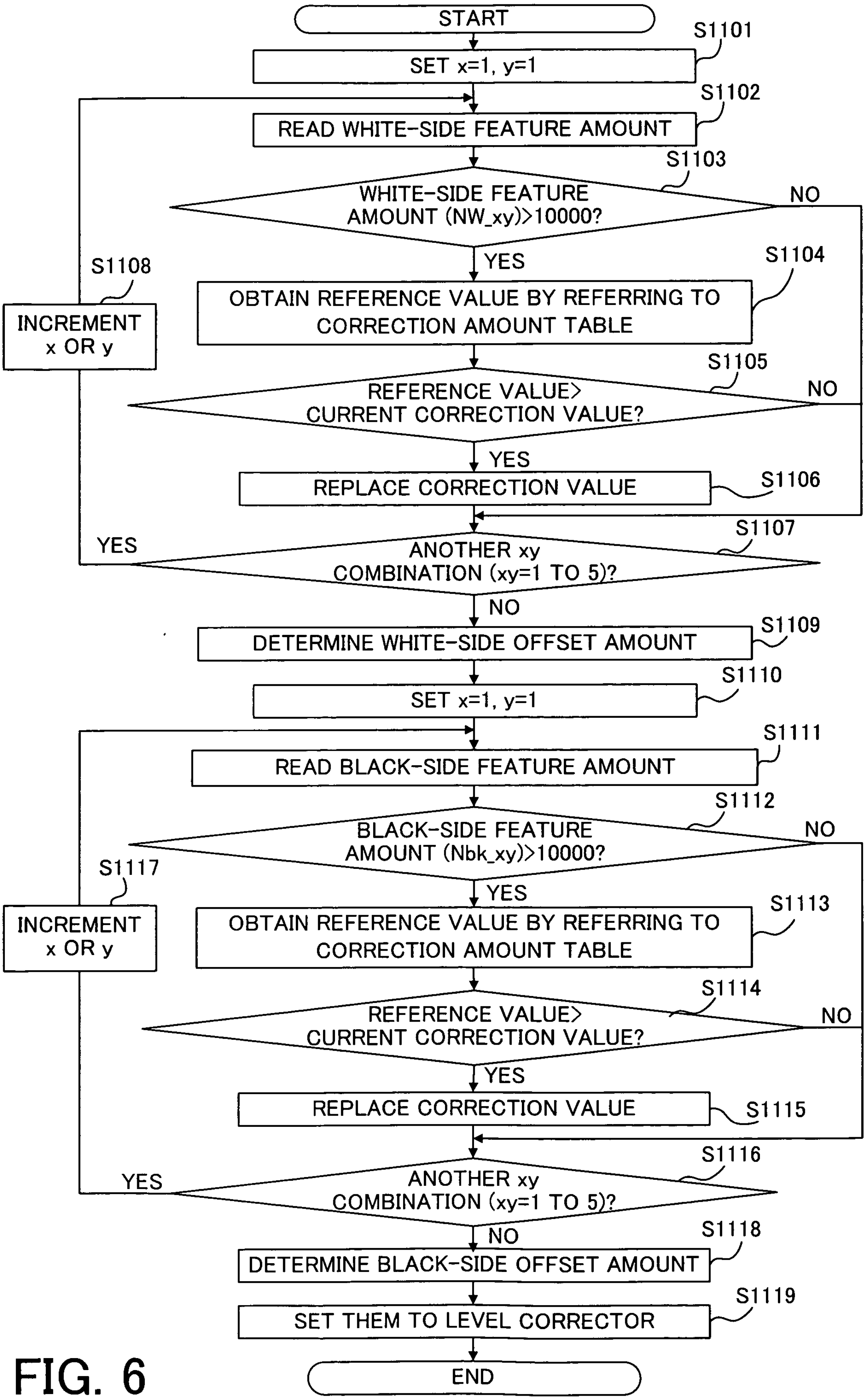
START
S1101
SET x=1, y=1
S1102
READ WHITE-SIDE FEATURE AMOUNT
S1103
WHITE-SIDE FEATURE AMOUNT (NW_xy)>10000?
NO
YES
S1104
OBTAIN REFERENCE VALUE BY REFERRING TO CORRECTION AMOUNT TABLE
S1105
REFERENCE VALUE> CURRENT CORRECTION VALUE?
NO
YES
REPLACE CORRECTION VALUE
S1106
S1107
ANOTHER xy COMBINATION (xy=1 TO 5)?
YES
S1108
INCREMENT x OR y
NO
S1109
DETERMINE WHITE-SIDE OFFSET AMOUNT
S1110
SET x=1, y=1
S1111
READ BLACK-SIDE FEATURE AMOUNT
S1112
BLACK-SIDE FEATURE AMOUNT (Nbk_xy)>10000?
NO
YES
S1113
OBTAIN REFERENCE VALUE BY REFERRING TO CORRECTION AMOUNT TABLE
S1114
REFERENCE VALUE> CURRENT CORRECTION VALUE?
NO
YES
REPLACE CORRECTION VALUE
S1115
S1116
ANOTHER xy COMBINATION (xy=1 TO 5)?
YES
S1117
INCREMENT x OR y
NO
S1118
DETERMINE BLACK-SIDE OFFSET AMOUNT
S1119
SET THEM TO LEVEL CORRECTOR
END

FIG. 6

Nw_xy

	y=1	y=2	y=3	y=4	y=5
x=1	1	2	2	3	5
x=2	1	2	2	3	5
x=3	2	3	3	4	5
x=4	2	3	4	5	6
x=5	3	4	5	6	7

FIG. 7A

Nbk_xy

	y=1	y=2	y=3	y=4	y=5
x=1	1	2	3	4	5
x=2	0	1	2	3	4
x=3	0	0	1	2	3
x=4	0	0	0	1	2
x=5	0	0	0	0	1

FIG. 7B

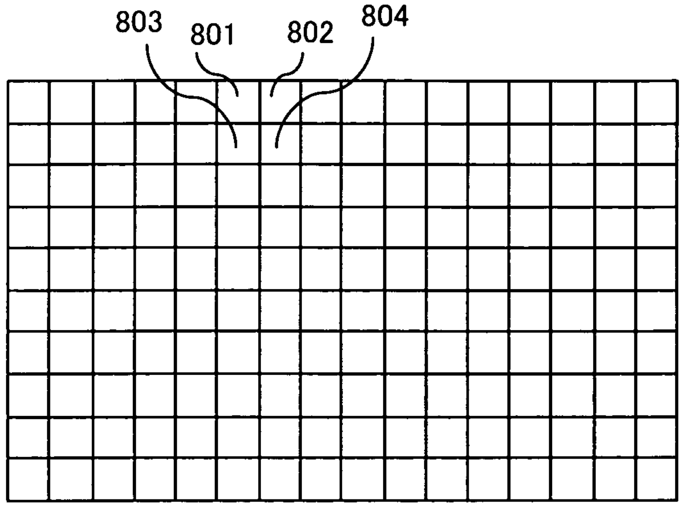
803
801
802
804

FIG. 8A

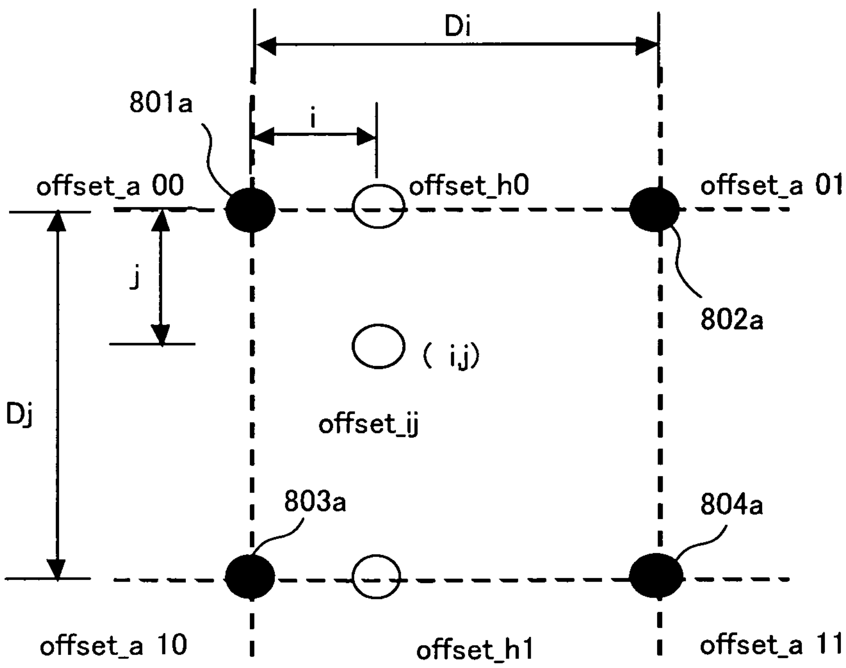
Di
801a
i
offset_a 00
offset_h0
offset_a 01
j
802a
(i,j)
Dj
offset_ij
803a
804a
offset_a 10
offset_h1
offset_a 11

FIG. 8B

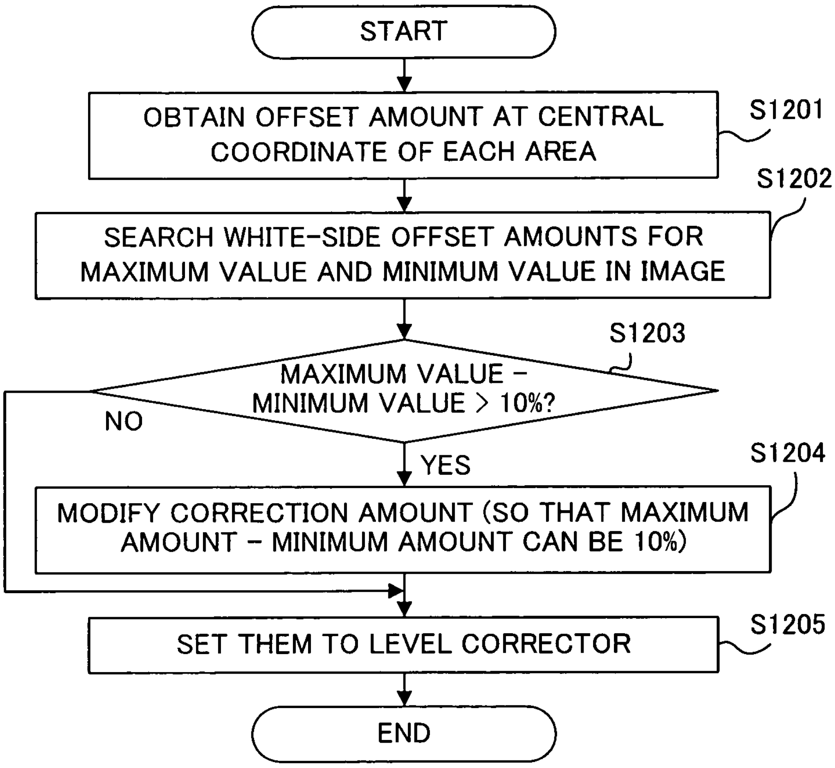
START
OBTAIN OFFSET AMOUNT AT CENTRAL COORDINATE OF EACH AREA
S1201
SEARCH WHITE-SIDE OFFSET AMOUNTS FOR MAXIMUM VALUE AND MINIMUM VALUE IN IMAGE
S1202
MAXIMUM VALUE − MINIMUM VALUE > 10%?
S1203
NO
YES
MODIFY CORRECTION AMOUNT (SO THAT MAXIMUM AMOUNT − MINIMUM AMOUNT CAN BE 10%)
S1204
SET THEM TO LEVEL CORRECTOR
S1205
END

FIG. 9

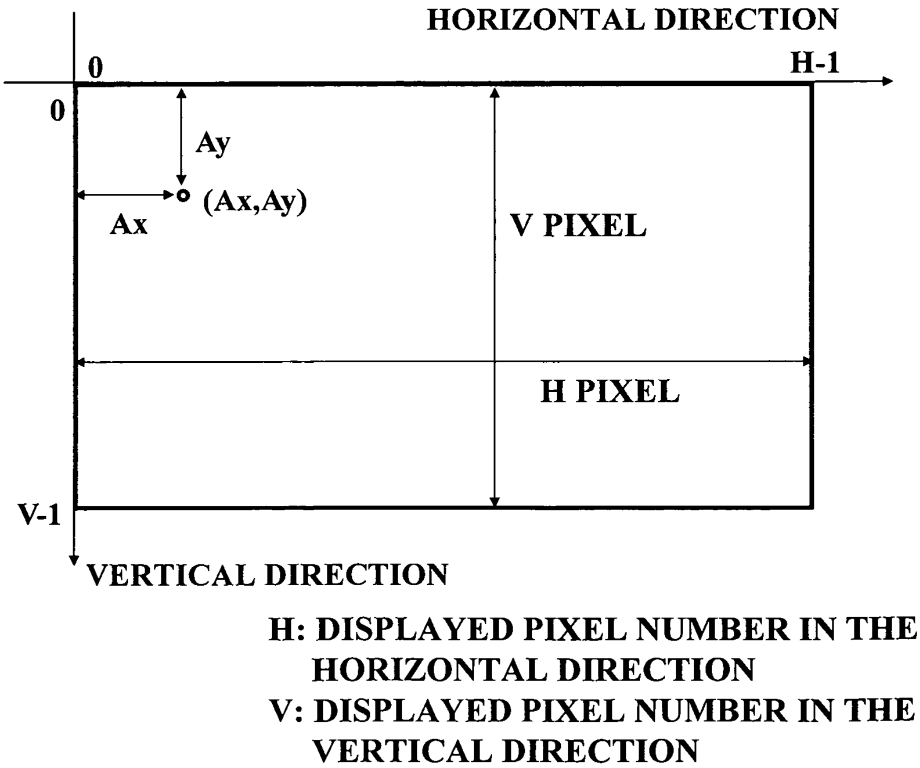
HORIZONTAL DIRECTION
0
H-1
0
Ay
(Ax,Ay)
Ax
V PIXEL
H PIXEL
V-1
VERTICAL DIRECTION
H: DISPLAYED PIXEL NUMBER IN THE HORIZONTAL DIRECTION
V: DISPLAYED PIXEL NUMBER IN THE VERTICAL DIRECTION

FIG. 10

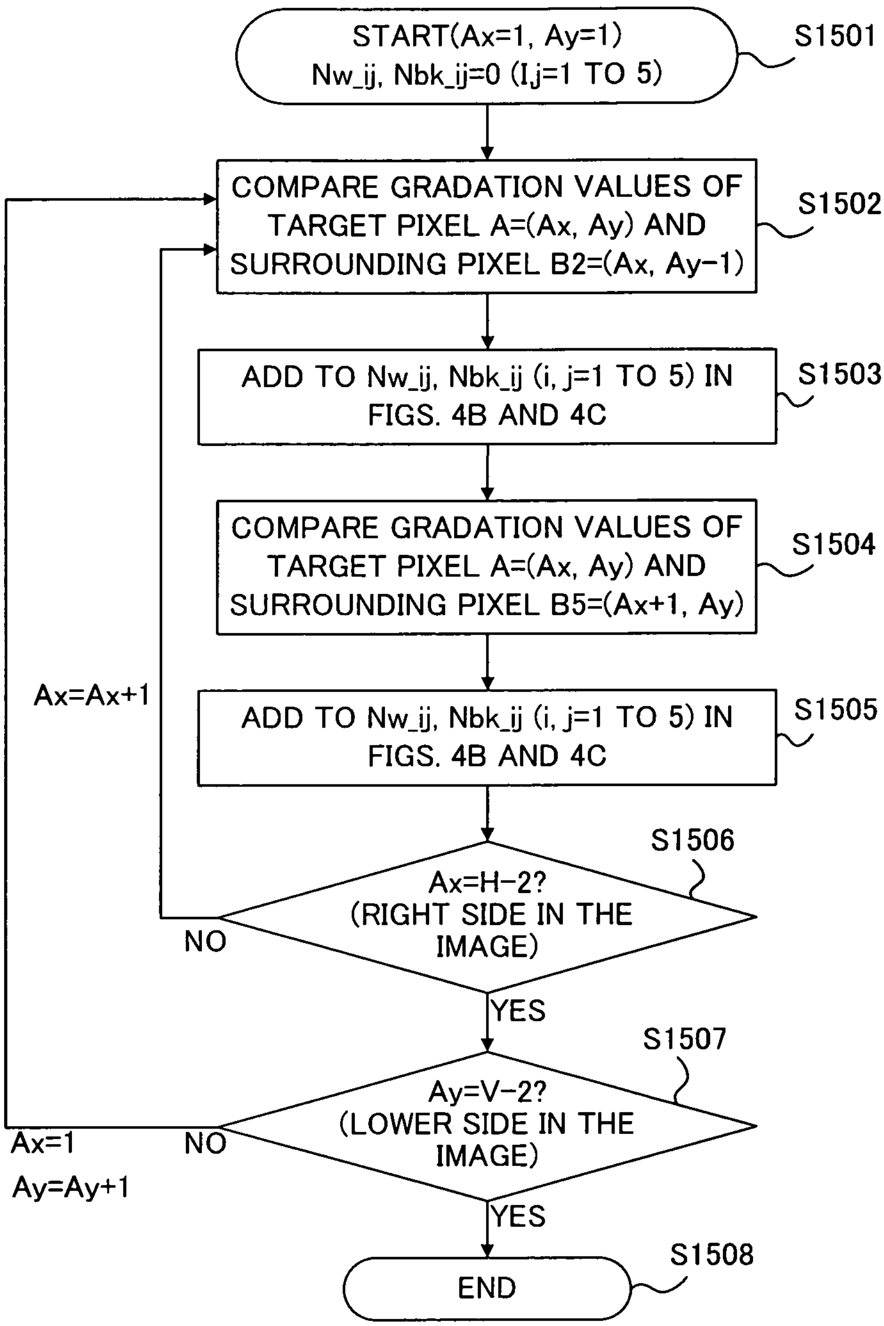
START(Ax=1, Ay=1)
Nw_ij, Nbk_ij=0 (I,j=1 TO 5)
S1501
COMPARE GRADATION VALUES OF TARGET PIXEL A=(Ax, Ay) AND SURROUNDING PIXEL B2=(Ax, Ay−1)
S1502
ADD TO Nw_ij, Nbk_ij (i, j=1 TO 5) IN FIGS. 4B AND 4C
S1503
COMPARE GRADATION VALUES OF TARGET PIXEL A=(Ax, Ay) AND SURROUNDING PIXEL B5=(Ax+1, Ay)
S1504
ADD TO Nw_ij, Nbk_ij (i, j=1 TO 5) IN FIGS. 4B AND 4C
S1505
Ax=Ax+1
S1506
Ax=H−2?
(RIGHT SIDE IN THE IMAGE)
NO
YES
S1507
Ay=V−2?
(LOWER SIDE IN THE IMAGE)
Ax=1
Ay=Ay+1
NO
YES
S1508
END

FIG. 11

REFERENCES CITED IN THE DESCRIPTION

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- US 20080018630 A1 **[0004]**
- US 20020097207 A1 **[0004]**
- JP 2009069608 A **[0004]**

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申请(专利权)人(译)	佳能株式会社		
当前申请(专利权)人(译)	佳能株式会社		
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优先权	2011065099 2011-03-24 JP		
其他公开文献	EP2503539A2 EP2503539A3		
外部链接	Espacenet		

摘要(译)

液晶显示装置（100）包括特征量生成器（20），其被配置为基于满足目标像素的灰度值与周围像素的灰度值之间的对应关系的像素对的数量来生成特征量。用于由输入图像信号表示的图像的目标像素，处理器（30），被配置为当特征量大于第一阈值时设置减小输入图像信号的灰度值的动态范围的校正值，以及以便在特征量等于或小于第一阈值时不设置校正值，并且液晶驱动器（50）被配置为基于已经输入的图像信号驱动液晶显示元件（66）通过校正值校正。

Expression 1

$$offset\_h0 = offset\_a00 + \frac{i}{Di}(offset\_a01 - offset\_a00)$$