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(54) **Data processing device and display system including the same with compensation for missing colours in a displayed text**

Datenverarbeitungsvorrichtung und Anzeigesystem damit mit Kompensation fehlender Farben in einem angezeigten Text

Dispositif de traitement de données et système d'affichage le comprenant avec compensation de couleurs manquantes dans un texte affiché

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Description

BACKGROUND

1. Field

[0001] The disclosure relates to a data processing device, and more particularly, to a data processing device that selectively compensates data having information of text and a display system including the data processing device.

2. Description of the Related Art

[0002] A conventional display device displays an image using a display panel including a plurality of logical pixels, each of which includes sub-pixels that expresses red, green and blue, for example.

[0003] Recently, a pentile technology for improving brightness of a display device by designing one logical pixel to have parts of red, green, blue and optional color sub-pixels is being developed. In such a display device having a pentile structure, an opening ratio and a penetration ratio of the display device may be substantially improved.

[0004] In such a display device having the pentile structure, data having information of red, green, blue and optional color is applied to one logical pixel. However, since one logical pixel includes parts of red, green, blue and optional color sub-pixels, it may display only parts of red, green, blue and optional color.

[0005] US20090058873A1 describes systems and methods of rendering image data to multiprimary displays that adjust image data across metamers are herein disclosed. The metamer filtering is based upon input image content and optimizes subpixel values to improve image rendering accuracy or perception. One embodiment comprises a display system comprising: a display, said display comprising at least a first set of subpixels and a second set of subpixels further comprising at least one metamer; an input image data unit; a spatial frequency detection unit, said spatial frequency detection unit extracting a spatial frequency characteristic from said input image data; and an adjustment unit, said adjustment unit adjusting image data of said first set and said second set of subpixels according to said spatial frequency characteristic.

[0006] US20130027285A1 describes a four-color liquid crystal display device with pixels containing first to fourth subpixels having four different colors, respectively, arranged in a two-by-two matrix, the first to fourth subpixels being placed in the first row and the first column, in the first row and the second column, in the second row and the second column, and in the second row and the first column, respectively.US20030227466A1 describes a dropout control in which one or more samples are added to adjacent samples that fall within an image outline. The samples are used in sub-pixel rendering to compensate for unnaturally thin or faint object stems. Horizontal dropout control operations are provided to add samples to sets of horizontally adjacent samples such that each set of samples comprises a minimum number of samples. Vertical dropout control operations are provided to position samples such that the weighted anti-aliasing filtering will take sufficient account of the samples.

[0007] JP2009055121A describes an image processing device which enhances the output image quality by enhancing the detection accuracy of characters existing in a dot area of non-white ground. A line width control section controls the line width for character region detection, when a ground area or a dot area is determined by using the determination results of a ground judging section and a dot judging section. As control content, detection width is made thin, regarding the detection of a character having ground density in the dot matrix.

[0008] US6266439B1 describes an image processor which receives color signals representing a color or black-and-white image, typically containing text and non-text areas. A sliding window or swath of the image is processed which progressively moves over the virtual image. A spatial filter is applied to sharpen the image and it is then classified into text and non-text regions. The data from the text regions is subjected to a black text enhancement process in which the color signal from a single channel is thresholded against two thresholds. The lower threshold identifies pixels for being set to black, whereas the higher threshold identifies "support" pixels used in component connectivity analysis.

SUMMARY

[0009] The data processing device of the invention is defined in claim 1. Advantageous embodiments are defined in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The features of the invention will become readily apparent by reference to the following detailed description when considered in conjunction with the accompanying drawings, in which:

FIG. 1 is a block diagram showing an exemplary embodiment of a display system having a data processing device according to the invention.

FIG. 2 is a block diagram showing the display device illustrated in FIG. 1.

FIG. 3 is a block diagram illustrating the data processing device illustrated in FIGS. 1 and 2.

FIG. 4 is a block diagram illustrating the data analysis part of FIG. 3.

FIG. 5 is a drawing showing the operation of a histogram analysis part of FIG. 4.

FIG. 6 is an enlarged view of a portion of FIG. 5 including a second logical pixel block.

FIG. 7 is a drawing illustrating examples of images

corresponding to data, which is detected as a line.

FIG. 8 is a drawing illustrating examples of images corresponding to data, which is detected as an edge.

FIG. 9 is a drawing illustrating a top signal (I), a bottom signal (II), a high signal (III) and a low signal (IV) of an analysis signal.

FIG. 10 is a drawing illustrating analysis signals of a reference color and analysis signals of remaining colors when green is the reference color.

FIGS. 11A and 11B are drawings illustrating images displayed in a conventional display device.

FIGS. 12A and 12B are drawings illustrating images displayed in a display device.

FIGS. 13 through 18 are drawings illustrating a display panel.

DETAILED DESCRIPTION

[0011] The invention will be described more fully hereinafter with reference to the accompanying drawings, in which various embodiments are shown. This invention is set forth in the independent claims. Like reference numerals refer to like elements throughout.

[0012] It will be understood that when an element or layer is referred to as being "on", "connected to" or "coupled to" another element or layer, it can be directly on, connected or coupled to the other element or layer or intervening elements or layers may be present. In contrast, when an element is referred to as being "directly on," "directly connected to" or "directly coupled to" another element or layer, there are no intervening elements or layers present. Like numbers refer to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0013] It will be understood that, although the terms first, second, etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another element, component, region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the invention.

[0014] Spatially relative terms, such as "beneath", "below", "lower", "above", "upper" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, the exemplary term "below" can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

[0015] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms, "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "includes" and/or "including", when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0016] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0017] Exemplary embodiments are described herein with reference to cross section illustrations that are schematic illustrations of idealized embodiments. As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, embodiments described herein should not be construed as limited to the particular shapes of regions as illustrated herein but are to include deviations in shapes that result, for example, from manufacturing. For example, a region illustrated or described as flat may, typically, have rough and/or nonlinear features. Moreover, sharp angles that are illustrated may be rounded. Thus, the regions illustrated in the figures are schematic in nature and their shapes are not intended to illustrate the precise shape of a region and are not intended to limit the scope of the claims set forth herein.

[0018] All methods described herein can be performed in a suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., "such as"), is intended merely to better illustrate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention as used herein.

[0019] Hereinafter, exemplary embodiments of the invention will be described in detail with reference to the accompanying drawings.

[0020] FIG. 1 is a block diagram showing an exemplary

embodiment of a display system 10 having a data processing device 200 according to the invention.

[0021] Referring to FIG. 1, the display system 10 includes a rendering part 100, a data processing device 200 and a display device 300.

[0022] The rendering part 100 receives an image data RGB, and then renders the image data RGB to generate rendered image data RGBW. The rendered image data RGBW includes data corresponding to logical pixels in the display device 300.

[0023] The rendering part 100 maps image data RGB including red, green and blue data to the rendered image data RGBW including red, green, blue and optional color data. The optional color may be a color different from red, green and blue. The color data of the rendered image data RGBW may correspond to sub-pixels in the display device 300. The image data RGBW may include red, green, blue and white data.

[0024] The rendering part 100 may map red, green and blue gamut based on red, green and blue data to red, green, blue and optional color gamut using a gamut mapping algorithm ("GMA").

[0025] The rendering part 100 may linearize the image data RGB using a gamma function before rendering the image data RGB. The rendering part 100 may non-linearize the linearized image data RGB using a reverse gamma function.

[0026] The data processing device 200 receives the rendered image data RGBW, and then performs a data processing on the received rendered image data RGBW to output compensated data RGBW'.

[0027] FIG. 2 is a block diagram showing a display device illustrated in FIG. 1.

[0028] The display device 300 includes a display panel 310, a timing controller 320, a gate drive circuit 330 and a data drive circuit 340.

[0029] The display panel 310 includes a screen for displaying an image and includes a plurality of sub-pixels. The sub-pixels may have a pentile structure or a multi-primary color ("MPC") structure.

[0030] The sub-pixels may include base color sub-pixels and an optional color sub-pixel. The base color sub-pixels may include a red sub-pixel, a green sub-pixel and a blue sub-pixel. The optional color sub-pixel may include at least one of white, yellow, cyan and magenta sub-pixels. As shown in FIG. 2, the display panel 310 may include base color sub-pixels and a white sub-pixel, for example.

[0031] A plurality of logical pixels 1LP to 4LP is defined in the display panel 310. As shown in FIG. 2, the display panel 310 includes first through fourth logical pixels 1LP to 4LP, for example. In FIG. 2, only four logical pixels 1LP to 4LP are shown for convenience of illustration, but the first through fourth logical pixels 1LP to 4LP may be repeatedly arranged in the display panel 310.

[0032] Each of the first through fourth logical pixels 1LP to 4LP includes at least one of red, green, blue and optional color sub-pixels. In one exemplary embodiment, for example, each of the first logical pixel 1LP and the fourth logical pixel 4LP includes a red ("R") sub-pixel and a green ("G") sub-pixel, and each of the second logical pixel 2LP and the third logical pixel 3LP includes a blue ("B") sub-pixel and a white ("W") sub-pixel. As shown in FIG. 2, each of the logical pixels 1LP to 4LP may include two sub-pixels, but the invention is not limited thereto. Each of the logical pixels 1LP to 4LP may include at least one of red, green, blue and optional color sub-pixels, and the logical pixels 1LP to 4LP may be variously defined.

[0033] Image data that the display device 300 receives from the data processing device 200, e.g., the compensated image data RGBW', may include red, green, blue and white data corresponding to the first through fourth logical pixels 1LP to 4LP. Each of the first through fourth logical pixels 1LP to 4LP may display a portion of red, green, blue and white data. In such an example, first data corresponding to the first logical pixel 1LP includes red, green, blue and white data, but only red and green may be displayed by the first logical pixel 1LP. In such an example, second data corresponding to the second logical pixel 2LP includes red, green, blue and white data, but only blue and white may be displayed by the second logical pixel 2LP.

[0034] The data processing device 200 provides the compensated data RGBW' to the timing controller 320. The data processing device 200 may be included in the display device 300, e.g., in the timing controller 320 of the display device 300.

[0035] The timing controller 320 converts a data format of the compensated data RGBW' into a data format corresponding to the data drive circuit 340, and provides the compensated data RGBW' to the data drive circuit 340. The timing controller 320 receives control signals O-CS and converts the control signals O-CS into a data control signal DCS and a gate control signal GCS. The timing controller 320 provides the data control signal DCS to the data drive circuit 340, and provides the gate control signal GCS to the gate drive circuit 330.

[0036] The data drive circuit 340 converts the compensated data RGBW' into a data voltage in response to the data control signal DCS, and provides the data voltage to the display panel 310. The gate drive circuit 330 sequentially outputs gate signals for driving the sub-pixels on a row-by-row basis in response to the gate control signal GCS.

[0037] FIG. 3 is a block diagram illustrating the data processing device 200 illustrated in FIGS. 1 and 2. FIG. 4 is a block diagram illustrating the data analysis part of FIG. 3.

[0038] Referring to FIGS. 3 and 4, the data processing device 200 includes a data analysis part 201 and a data compensation part 250.

[0039] The data analysis part 201 analyzes data provided thereto on a block-by-block basis, e.g., analyzes each image block of an image corresponding to the rendered image data RGBW, and the data analysis part 201 provides a result of analysis to the data compensation

part 250. The data analysis part 201 analyzes information of text, color, line and edge in each data corresponding to the block.

[0040] As shown in FIG. 4, the data analysis part 201 includes a histogram analysis part 210, a text judgment part 220, a line/edge detection part 230 and a color analysis part 240.

[0041] FIG. 5 is a drawing for explaining an operation of the histogram analysis part 210 of FIG. 4. As shown in FIG. 5, a green text "H" may be displayed on a black background in a first logical pixel block LB1 of the display panel 310. The first logical pixel block LB1 may be defined by a plurality of logical pixels, and data corresponding to the first logical pixel block LB1 may be a unit data for histogram analysis. A plurality of first logical pixel blocks may be defined in the display panel 310, and each first logical pixel block may display an image corresponding to a unit data for histogram analysis.

[0042] Referring to FIGS. 3 through 5, the histogram analysis part 210 receives the rendered image data RGBW, performs a histogram analysis on the data corresponding to the first logical pixel block LB1 of the rendered image data RGBW, and thereby determines color of text and background of an image displayed in the first logical pixel block LB1.

[0043] The histogram analysis part 210 analyzes the distribution of grayscale value of red, green and blue data of the data corresponding to the first logical pixel block LB1, and detects color having a grayscale value greater than a first predetermined value. In such an embodiment, when each of two or more colors have a grayscale value greater than the first predetermined value, the histogram analysis part 210 detects a color having the smallest volume of distribution in the first logical pixel block LB1 as a text color, and detects the other colors as a background color. The first predetermined value may be set based on the minimum grayscale value of the color of text that is displayed in the first logical pixel block LB1.

[0044] As shown in FIG. 5, the histogram analysis part 210 may determine the green and black have a volume of distribution greater than the first predetermined value and detects green, which has the less volume of distribution, as a text and the black as a background.

[0045] The first logical pixel block LB1 may be defined by at least about 10,000 logical pixels that are adjacent to one another. In one example, the first logical pixel block LB1 may be defined by 100 $\times$ 100 logical pixels. In another example, the display panel 310 may include 2,000 $\times$ 1,000 logical pixels, and the histogram analysis part 210 performs a histogram analysis on every data corresponding to 200 first logical pixel blocks LB1.

[0046] The first logical pixel block LB1 is defined by logical pixels greater than 100 $\times$ 100, such that text color and background color are substantially accurately detected when the background has more than one color, or text is large and thick.

[0047] The histogram analysis part 210 may perform a function (e.g., determining whether text exists in the data corresponding to the first logical pixel block LB1), which may be performed in another part (e.g., text judgment part 220), such that accuracy in detecting information of text is substantially improved.

[0048] The histogram analysis part 210 outputs the information of text and a background of data corresponding to the first logical pixel block LB1 as a first histogram signal SGN_H1. When data corresponding to the first logical pixel block LB1 do not include information of text, for example, when the first logical pixel block LB1 is displayed with a solid color background, the histogram analysis part 210 outputs a second histogram signal SGN_H2.

[0049] The histogram analysis part 210 provides the first histogram signal SGN_H1 or the second histogram signal SGN_H2 to the data compensation part 250.

[0050] FIG. 6 is an enlarged view of a portion including a second logical pixel block of FIG. 5. In FIG. 6, an enlarged view of 8 $\times$ 8 logical pixels in the first logical pixel block LB1 of FIG. 5 are illustrated. In FIG. 6, data corresponding to logical pixels in a first logical pixel column and a second logical pixel column have information of green, and data corresponding to the remaining logical pixels have information of black.

[0051] As described above, each of the logical pixels, e.g., each of first to ninth logical pixels LP1 to LP9, may include red and green sub-pixels or blue and white sub-pixels. Each of the first logical pixel LP1, the third logical pixel LP3, the fifth logical pixel LP5, the seventh logical pixel LP7 and the ninth logical pixel LP9 may include red and green sub-pixels. Each of the second logical pixel LP2, the fourth logical pixel LP4, the sixth logical pixel LP6 and the eighth logical pixel LP8 may include blue and white sub-pixels.

[0052] Data corresponding to the second logical pixel LP2, the fourth logical pixel LP4 and the eighth logical pixel LP8 have information of green. However, each of the second logical pixel LP2, the fourth logical pixel LP4 and the eighth logical pixel LP8 does not include a green sub-pixel such that green may not be displayed therein. Accordingly, a boundary of a text, e.g., "H" in FIG. 5, may not be effectively displayed. In case of displaying a maximally enlarged image, a boundary of green text "H" may crumble such that the green text "H" may not be effectively recognized by a viewer.

[0053] Referring to FIGS. 3, 4 and 6, the text judgment part 220 receives data, e.g., the rendered image data RGBW, and analyzes data corresponding to a second logical pixel block LB2 to detect whether the data includes information of text or not. The text judgment part 220 scans the data (the rendered image data RGBW of FIG. 2) corresponding to the first logical pixel block LB1 in the unit of data corresponding to the second logical pixel block LB2 while moving the second logical pixel block LB2 by a logical pixel row unit or a logical pixel column unit.

[0054] As shown in FIG. 6, the second logical pixel block LB2 may include at least 3 $\times$ 3 logical pixels. As

the number of logical pixels included in the second logical pixel block LB2 increases, reliability is improved but the number of the operation to be performed increases. The number of logical pixels in the second logical pixel block LB2 is less than the number of logical pixels in the first logical pixel block LB1. Hereinafter, an exemplary embodiment, where the second logical pixel block LB2 includes 3 x 3 logical pixels, will be described in further detail, for convenience of description.

[0055] The rendered image data RGBW includes first through ninth data corresponding to the first through ninth logical pixels LP1 to LP9 of the second logical pixel block LB2, respectively.

[0056] The text judgment part 220 compares the maximum grayscale value of red, green and blue data of each of the first through ninth data with a second predetermined value to detect the information of text therein. The second predetermined value is the minimum grayscale value to be recognized as text having a color. The text judgment part 220 analyzes the first through ninth data to detect grayscale values of red, green, blue and white data therein. In such an embodiment, where each of the first data, the second data, the fourth data, the fifth data, the seventh data and the eighth data has a same specific grayscale value of green, the text judgment part 220 detect one of the grayscale value of the first data, the second data, the fourth data, the fifth data, the seventh data and the eighth data as the maximum grayscale value. When the detected maximum gradation value is greater than the second predetermined value with respect to the green color, the text judgment part 220 determines that the information of text exists in the first through ninth data. When the detected maximum gradation value is less than the second predetermined value with respect to the green color, the text judgment part 220 determines that the information of text does not exist in the first through ninth data. In an exemplary embodiment, where the second predetermined value may be 100, for example, when the detected maximum grayscale value is 200, the text judgment part 220 determines that the information of text exists in the first through ninth data, and when the detected maximum grayscale value is 10, the text judgment part 220 determines that the information of text does not exist in the first through ninth data.

[0057] The text judgment part 220 moves the second logical pixel block LB2 in a row or column direction after analyzing the first through ninth data corresponding to the second logical pixel block LB2, and then analyzes data corresponding to a next second logical pixel block LB2' to detect whether the information of text exists in the next second logical pixel block LB2'. The text judgment part 220 analyzes an entire of the data in the first logical pixel block LB1 in such a manner by using the second logical pixel block LB2 as a unit of analysis. In an exemplary embodiment, as described above, the text judgment part 220 may scan the second logical pixel block LB2 while moving the second logical pixel block LB2 by one logical pixel row unit or one logical pixel column unit. In an alternative exemplary embodiment, the text judgment part 220 may scan the second logical pixel block LB2 while moving the second logical pixel block LB2 by more than one logical pixel row unit or more than one logical pixel column unit. In such an embodiment, the second logical pixel block LB2 may not be moved by more than three logical pixel row unit or more than three logical pixel column unit to scan the entire of the data of the first logical pixel block LB1.

[0058] In an exemplary embodiment, when data corresponding to the second logical pixel block LB2 include information of the text, the text judgment part 220 outputs a first text signal SGN_T1 to the line/edge detection part 230 and the color analysis part 240. In such an embodiment, when data corresponding to the second logical pixel block LB2 do not include information of text, the text judgment part 220 outputs a second text signal SGN_T2 to the data compensation part 250.

[0059] In such an embodiment, where the text judgment part 220 judges whether the information of text exists or not, based on the maximum grayscale value of data corresponding to the second logical pixel block LB2 when the maximum grayscale value is greater than the second predetermined value, the text judgment part 220 outputs the first text signal SGN_T1 even in a case where all of the nine data correspond to text or a background.

[0060] The line/edge detection part 230 detects whether or not the data corresponds to a line or an edge with respect to the red, green and blue colors, based on the first text signal SGN_T1 provided from the text judgment part 220. The line/edge detection part 230 scans the entire of the data corresponding to the first logical pixel block LB1 using the second logical pixel block LB2 as a unit of scanning.

[0061] The second logical pixel block LB2 includes a reference logical pixel and adjacent logical pixels, which are adjacent to the reference logical pixel and surround the reference logical pixel. In FIG. 6, the reference logical pixel is the fifth logical pixel LP5 and the adjacent logical pixels are the first through fourth logical pixels LP1 to LP4 and the sixth through ninth logical pixels LP6 to LP9.

[0062] The line/edge detection part 230 detects a grayscale difference between data corresponding to the reference logical pixel (hereinafter, referred to as "reference data") and data corresponding to the adjacent logical pixels (hereinafter, referred to as "adjacent data") for each of the red, green and blue data. The line/edge detection part 230 detects a number of the grayscale difference greater than a third predetermined value among the grayscale differences between the reference data and the adjacent data. The line/edge detection part 230 detects the reference data as a line, an edge or a remainder other than the line and the edge based on the detected number of the grayscale difference greater than a third predetermined value. In an exemplary embodiment, the third predetermined value may be set to the minimum value of a grayscale difference between a text and a background. In such an embodiment, the third predetermined value

may be less than the second predetermined value.

[0063] The line/edge detection part 230 determines the reference data as an edge when the detected number (N) of the grayscale difference greater than the third predetermined value satisfies the following inequation: $0 \leq N \leq 3$, determines the reference data as a line when the detected number (N) of the grayscale difference greater than the third predetermined value satisfies the following inequation: $3 \leq N \leq 8$, and determines the reference data as the remainder when the detected number (N) of the grayscale difference greater than the third predetermined value is zero (0), that is, N=0. As described above, the remainder means that the reference data does not correspond to an edge or a line. When all of the nine data in the second logical pixel block LB2 correspond to text or a background, the data are determined as the remainder. When the reference data is determined as a line, the reference data means that text and a background are constituted by a single line. When the reference data is determined as an edge, the reference data constitutes an outer covering of a text or background.

[0064] FIG. 7 is a drawing illustrating examples of the reference data detected as a line. FIG. 8 is a drawing illustrating examples of the reference data detected as an edge. In FIGS. 7 and 8, a grayscale difference between data corresponding to a logical pixel, in which an oblique line is drawn, and data corresponding to a logical pixel, in which an oblique line is not drawn, is greater than the third predetermined value.

[0065] In the second logical pixel block LB2 illustrated in FIG. 6, the line/edge detection part 230 detects a grayscale difference between fifth data corresponding to the fifth logical pixel LP5 and adjacent data corresponding to the adjacent logical pixels LP1 to LP4, LP6 to LP9 for each of the red, green and blue data. In the second logical pixel block LB2 shown in FIG. 6, first data, second data, fourth data, seventh data and eighth data have the same green grayscale value as the fifth data, a grayscale difference is not detected therebetween. In the second logical pixel block LB2 shown in FIG. 6, third data, sixth data and ninth data have a green grayscale difference with respect to the fifth data, and the green grayscale difference is greater than the third predetermined value. Accordingly, the number of data in which the detected green grayscale difference is greater than the third predetermined value is 3, and the line/edge detection part 230 determines the fifth data as an edge with respect to the green color. Since red and blue grayscale difference between the fifth data and adjacent data does not exist, the line/edge detection part 230 determines that the fifth data is neither an edge nor a line with respect to the red and blue colors.

[0066] The line/edge detection part 230 scans the entire of the data corresponding to the first logical pixel block LB1 using the second logical pixel block LB2 as a unit of scanning while moving the second logical pixel block LB2 by one logical pixel row unit or one logical pixel column unit.

[0067] When the data corresponding to the second logical pixel block LB2 is detected as a line or an edge, the line/edge detection part 230 provides a first detection signal SGN_D1 to the data compensation part 250. When the data is detected as the remainder, the line/edge detection part 230 provides a second detection signal SGN_D2 to the data to the data compensation part 250.

[0068] The line/edge detection part 230 detects whether or not the data provided thereto corresponds to a line or an edge with respect to the red, green and blue colors based on the first text signal SGN_T1 provided from the text judgment part 220.

[0069] Referring to FIGS. 4 and 6, the color analysis part 240 detects colors in each of the data provided thereto, e.g., the data corresponding to the first logical pixel block LB1, based on the first text signal SGN_T1. The color analysis part 240 scans entire of the data corresponding to the first logical pixel block LB1 using the second logical pixel block LB2 as a unit of analysis.

[0070] The color analysis part 240 compares the adjacent data with a reference data to generate an analysis signal SGN_A of the data for each of the red, green and blue data. When the color analysis part 240 analyzes the adjacent data with respect to one color, the analysis signal SGN_A includes an analysis signal of a reference color and an analysis signal of remaining colors other than the reference color. The analysis signal of the reference color and the analysis signal of the remaining colors may be a top signal, a bottom signal, a high signal or a low signal.

[0071] FIG. 9 is a drawing illustrating a top signal (I), a bottom signal (II), a high signal (III) and a low signal (IV) of an analysis signal.

[0072] Referring to FIG. 9, the top signal is a signal that is generated when data of a reference color exist in the reference data and does not exist at least a portion of the adjacent data. In the second logical pixel block LB2 of FIG. 6, where green is the reference color, the fifth data has data of green but the third, sixth and ninth data among the adjacent data do not have data of green, the color analysis part 240 generates the top signal with respect to the green color based on a result of the analysis of data corresponding to the second logical pixel block LB2.

[0073] The bottom signal is a signal which is generated when data of the reference color does not exist in the reference data and exists in at least a portion of the adjacent data. In the next second logical pixel block LB2' of FIG. 6, the reference logical pixel is a sixth logical pixel LP6, and the sixth data is the reference data. In the next second logical pixel block LB2', the sixth data does not have data of green but the second, fifth and eighth data among the adjacent data have data of green, the color analysis part 240 generates the bottom signal with respect to the green color based on a result of the analysis of data corresponding to the next second logical pixel block LB2'.

[0074] The high signal is a signal which is generated

when data of the reference color exists in the reference data and all of the adjacent data. When green is the reference color, when all data corresponding to the second logical pixel block LB2 have data of green, the color analysis part 240 generates the high signal with respect to the green color.

[0075] The low signal is a signal which is generated when data of the reference color does not exist in the reference data and all of the adjacent data. When green is the reference color and all data corresponding to the second logical pixel block LB2 do not have data of green, the color analysis part 240 generates the low signal with respect to the green color.

[0076] Referring to FIGS. 4 and 6, the color analysis part 240 generates an analysis signal of the reference color and an analysis signal of the remaining colors for each of the red, green and blue colors. As shown in FIG. 6, when green is set as the reference color, the color analysis part 240 generates the top signal with respect to the green color and generates the bottom signal with respect to the red and blue color. When red is set as the reference color, the color analysis part 240 generates the low signal with respect to the red color and generates the low signal with respect to the green and blue colors. When blue is set as the reference color, the color analysis part 240 generates the low signal with respect to the blue color and generates the low signal with respect to the red and green colors.

[0077] The color analysis part 240 provides the analysis signal SGN_A to the data compensation part 250.

[0078] FIG. 10 is a drawing illustrating analysis signals A_G of a reference color and analysis signals A_RB of the remaining colors generated when green is set as the reference color. Since green is set as the reference color, the remaining colors are red and blue colors.

[0079] As shown in (A) of FIG. 10, when a top signal is generated with respect to the green color and a low signal is generated with respect to the red and blue color, a reference data has information of green and at least a portion of adjacent data has information of black. As shown in (B) of FIG. 10, when a bottom signal is generated with respect to the green color and a low signal is generated with respect to the red and blue colors, the reference data has information of black and at least a portion of adjacent data has information of green. As shown in (C) of FIG. 10, when a high signal is generated with respect to the green color and a bottom signal is generated with respect to the red and blue colors, the reference data has information of green and at least a portion of adjacent data has information of white. As shown in (D) of FIG. 10, when a high signal is generated with respect to the green color and a top signal is generated with respect to the red and blue colors, the reference data has information of white and at least a portion of adjacent data has information of green. As shown in (E) of FIG. 10, when a top signal is generated with respect to the green color and a top signal is generated with respect to the red and blue colors, the reference data has information of white and at least a portion of adjacent data has information of black. As shown in (F) of FIG. 10, when a bottom signal is generated with respect to the green color and a bottom signal is generated with respect to the red and blue colors, the reference data has information of black and at least a portion of adjacent data has information of white.

[0080] Referring to FIGS. 3 and 4, the data compensation part 250 detects the color information, text information, background information and a line/edge information in the data provided thereto based on the first histogram signal SGN_H1, the first detection signal SGN_D1 and the analysis signal SGN_A.

[0081] The data compensation part 250 compensates data corresponding to a logical pixel that does not include a color pixel corresponding to the color of text among data having information of text (hereinafter it is referred to as text data) based on information analyzed by and provided from the data analysis part 201. The data compensation part 250 generates and provides compensated data RGBW' to the display device 300 of FIG. 1.

[0082] As shown in FIG. 2, the first logical pixel LP1 of FIG. 6 may include red and green sub-pixels and the second logical pixel LP2 may include blue and white sub-pixels. The second data has information of green text but green color does not displayed in the second logical pixel LP2. Thus, the data compensation part 250 compensates the second data such that the second data has a blue or white grayscale value. In such an embodiment where there color of the text is green, the grayscale value of white color in the second data is compensated.

[0083] The data compensation part 250 selectively compensates data corresponding to text. According to FIG. 6, the data compensation part 250 may not compensate the third, sixth and ninth data corresponding to a background.

[0084] The data compensation part 250 may not compensate data not having information of text. The data compensation part 250 may not perform a compensation operation when the data compensation part 250 receives the second histogram signal SGN_H2, the second text signal SGN_T2 and/or the second detection signal SGN_D2, and the data compensation part 250 may not perform a compensation operation when all of the analysis signal SGN_A are the high signals or the low signals.

[0085] The data compensation method of the data compensation part 250 may be variously modified.

[0086] The data compensation part 250 may independently compensate an edge and line of the text data.

[0087] The data compensation part 250 may compensate at least one of an edge and line of the text data. In one exemplary embodiment, for example, the data compensation part 250 may compensate only an edge and may not compensate a line. In one alternative exemplary embodiment, for example, the data compensation part 250 may compensate only a line and may not compensate an edge. The data compensation part 250 may compensate both an edge and a line.

[0088] The data compensation part 250 may compensate an edge and line of the text data based on different grayscale values from each other. In the exemplary embodiment of FIG. 6, when the second data is an edge, the data compensation part 250 may compensate a white data of the second data such that the white grayscale has 70% of the maximum grayscale. In such an embodiment, when the second data is a line, the data compensation part 250 may compensate the white data of the second data such that the white grayscale has 30% of the maximum grayscale.

[0089] The data compensation part 250 may compensate an edge and line of the text data based on different colors from each other. In the exemplary embodiment of FIG. 6, when the second data is an edge, the data compensation part 250 may compensate the white data of the second data to have a specific grayscale and when the second data is a line, the data compensation part 250 may compensate the blue data of the second data to have a specific grayscale.

[0090] The data compensation part 250 may compensate the text data based on a background color. The data compensation part 250 may differently compensate text data having a first background color and text data having a second background color different from the first background color. The data compensation part 250 may differently compensate a grayscale value of the text data when the text data is a green text on a black background and a grayscale value of the text data when the text data is a green text on a blue background.

[0091] The data compensation part 250 may compensate a grayscale range based on a compensation color of the text data. The data compensation part 250 may compensate a white grayscale of the text data by about 5% to about 20% of the maximum grayscale, and may compensate an optional color grayscale other than red, green, blue and white by about 3% to about 5% of the maximum grayscale.

[0092] FIGS. 11A and 11B are drawings illustrating images displayed in a conventional display device. FIGS. 12A and 12B are drawings illustrating images displayed in an exemplary embodiment of a display device. FIG. 11B shows an enlarged view of four logical pixels of the image of FIG. 11A, and FIG. 12B shows an enlarged view of four logical pixels of the image of FIG. 12A. In FIGS. 11A, 11B, 12A and 12B, a conventional display device and an exemplary embodiment of a display device display a same green text on a black background.

[0093] As shown in FIGS. 11A, 11B, 12A and 12B, when a conventional display device and an exemplary embodiment of a display device display a same text, the data processing device 200 selectively compensates data corresponding to the text such that readability of the text in the image displayed by the exemplary embodiment of the display device is substantially improved compared to readability of text in an image displayed in the conventional display device.

[0094] FIG. 13 is a drawing illustrating an exemplary embodiment of a display panel 311.

[0095] The display panel 311 in FIG. 13 is substantially the same as the display panel 310 except for the number of the sub-pixels in one logical pixel and the type of sub-pixels.

[0096] Referring to FIG. 13, the display panel 311 may include first through fourth logical pixels 11LP to 41LP. In FIG. 13, only four logical pixels 11LP to 41LP are illustrated for convenience of illustration, but the first through fourth logical pixels 11LP to 41LP may be repeatedly arranged in the display panel 311.

[0097] Each of the first logical pixel 11LP and the fourth logical pixel 41LP may include red R sub-pixel, a green G sub-pixel and a blue B sub-pixel. Each of the second logical pixel 21LP and the third logical pixel 31LP may include a cyan C sub-pixel, a yellow Y sub-pixel and a blue B sub-pixel. The red R, green G, blue B, cyan C and yellow Y sub-pixels may have a same size.

[0098] FIG. 14 is a drawing illustrating an alternative exemplary embodiment of a display panel 312.

[0099] The display panel 312 may include first through fourth logical pixels 12LP to 42LP. In FIG. 14, only four logical pixels 12LP to 42LP are illustrated for convenience of illustration, but the first through fourth logical pixels 12LP to 42LP may be repeatedly arranged in the display panel 312.

[0100] Each of the first logical pixel 12LP and the fourth logical pixel 42LP may include cyan C sub-pixel and a yellow Y sub-pixel. Each of the second logical pixel 22LP and the third logical pixel 32LP may include a blue B sub-pixel and a white W sub-pixel. The white W, blue B, cyan C and yellow Y sub-pixels may have a same size.

[0101] FIG. 15 is a drawing illustrating another alternative exemplary embodiment of a display panel 313.

[0102] The display panel 313 may include first through fourth logical pixels 13LP to 43LP. In FIG. 15, only four logical pixels 13LP to 43LP are illustrated for convenience of illustration, but the first through fourth logical pixels 13LP to 43LP may be repeatedly disposed.

[0103] Each of the first logical pixel 13LP and the fourth logical pixel 43LP may include red R sub-pixel, a green G sub-pixel, a blue B sub-pixel and a white W sub-pixel. Each of the second logical pixel 23LP and the third logical pixel 33LP may include a cyan C sub-pixel, a yellow sub-pixel, a blue B sub-pixel and a white W sub-pixel. The red R, green G, blue B, cyan C, yellow Y and white W sub-pixels may have a same size.

[0104] FIG. 16 is a drawing illustrating another alternative exemplary embodiment of a display panel 314.

[0105] The display panel 314 may include first through fourth logical pixels 14LP to 44LP. In FIG. 16, only four logical pixels 14LP to 44LP are illustrated for convenience of illustration, but the first through fourth logical pixels 14LP to 44LP may be repeatedly arranged in the display panel 314.

[0106] Each of the first logical pixel 14LP and the fourth logical pixel 44LP may include red R sub-pixel and a green G sub-pixel. Each of the second logical pixel 24LP

and the third logical pixel 34LP may include a blue B sub-pixel and a green G sub-pixel.

[0107] Two sub-pixels in each of the first through fourth logical pixels 14LP to 44LP may have different sizes from each other. A shorter side length of one sub-pixel of the two sub-pixels may be about twice a shorter side length of the other sub-pixel of the two sub-pixels. In the first logical pixel 14LP, a shorter side length of red R sub-pixel may be about twice a shorter side length of green G sub-pixel. Similarly, in the second logical pixel 24LP, a shorter side length of blue B sub-pixel may be about twice a shorter side length of green G sub-pixel.

[0108] FIG. 17 is a drawing illustrating another alternative exemplary embodiment of a display panel 315.

[0109] The display panel 315 may include first through fourth logical pixels 15LP to 45LP. In FIG. 17, only four logical pixels 15LP to 45LP are illustrated for convenience of illustration, but the first through fourth logical pixels 15LP to 45LP may be repeatedly arranged in the display panel 315.

[0110] Each of the first logical pixel 15LP and the fourth logical pixel 45LP may include red R sub-pixel and a green G sub-pixel. Each of the second logical pixel 25LP and the third logical pixel 35LP may include a blue B sub-pixel and a green G sub-pixel.

[0111] Two sub-pixels included in each of the first through fourth logical pixels 15LP to 45LP may have different shapes from each other.

[0112] The green G sub-pixel has a rhombus shape and the red R sub-pixel and the blue sub-pixel may have a hexagonal shape. An area of the green G sub-pixel may be smaller than an area of the blue B sub-pixel and an area of the red R sub-pixel. The sum of the number of the red R sub-pixels and the number of the blue B sub-pixels may be the same as the number of the green G sub-pixels.

[0113] A length of a side of the rhombus shape of the green G sub-pixel may be substantially the same as a length of a corresponding side of the hexagonal shape of the blue B sub-pixel and as a length of a corresponding side of the hexagonal shape of the red R sub-pixel. A side of the green G sub-pixel may be disposed to be adjacent and substantially parallel to a side of the red R sub-pixel. A side of the green G sub-pixel may be disposed to be adjacent and substantially parallel to a side of the blue B sub-pixel. The two red R sub-pixels and the two blue B blue sub-pixels may be disposed to surround the green G sub-pixel.

[0114] FIG. 18 is a drawing illustrating another alternative exemplary embodiment of a display panel 316.

[0115] The display panel 316 may include first and fourth logical pixels 16LP and 26LP. In FIG. 18, only two logical pixels 16LP and 26LP are illustrated for convenience of illustration but the first and fourth logical pixels 16LP and 26LP may be repeatedly arranged in the display panel 316.

[0116] The first logical pixel 16LP may include a blue B sub-pixel and a red R sub-pixel. The second logical pixel 26LP may include a white W sub-pixel and a green G sub-pixel. The blue B, red R, white W and green G sub-pixels may have a same size.

[0117] According to exemplary embodiments of a data processing device, readability of text displayed in a display device is substantially improved by compensating data corresponding to a logical pixel that may not display color of the text among data having information of the text.

Claims

1. A data processing device (200), adapted to process and provide data to a plurality of logical pixels (LP) of a display device (300), comprising:

a data analysis part (201) adapted to analyze information of text, color, line or edge in each of the data; and

a data compensation part (250) adapted to compensate at least one of an edge or line of text data corresponding to a logical pixel (LP) which does not display a text color due to the text data among the data having the information of text based on the information analyzed in the data analysis part (201), and which does not compensate data not having information of text,

wherein each of the logical pixels (LP) of the display device (300) is a pixel comprising at least one of red, green, blue and optional color sub-pixels, wherein the red sub-pixel is adapted to display red color, the green sub-pixel is adapted to display green color, the blue sub-pixel is adapted to display blue color, and the optional color sub-pixel is adapted to display a color different from red, green and blue;

wherein the data analysis part (201) comprises:

a histogram analysis part (210) adapted to analyze the data corresponding to a first logical pixel block (LB1), which is defined by at least a portion of the logical pixels (LP), to determine a color of text and a color of background of an image to be displayed in the first logical pixel block (LB1), wherein the histogram analysis part (210) analyzes a distribution of grayscale of each of red, green and blue data of the data corresponding to the first logical pixel block (LB1), and when two or more of the red, green and blue data have a grayscale value greater than a first predetermined value, the histogram analysis part (210) detects a color having the smallest volume of distribution among colors of the of the red, green and blue data as the text color and detects a remaining color of the colors of the of the red, green and blue data as a background color

a text judgment part (220) adapted to analyze the data corresponding to a second logical pixel block (LB2) included in the first logical pixel block (LB1), the text judgment part (220) being a unit of analysis to detect whether or not the data corresponding to the second logical pixel block (LB2) include the information of text, and adapted to output a first text signal (SGN_T1) when the data corresponding to the second logical pixel block (LB2) include information of text, and adapted to output a second text signal (SGN_T2) to the data compensation part (250) when data corresponding to the second logical pixel block (LB2) do not include information of text;

wherein the logical pixels (LP) of the first logical pixel block (LB1) are arranged adjacent to one another and wherein the logical pixels (LP) of the second logical pixel block (LB2) are arranged adjacent to one another;

wherein the text judgment part (220) is adapted to compare a maximum grayscale value of the red, green and blue data of the data corresponding to the second logical pixel block (LB2) with a second predetermined value to detect whether the information of text exists in the data corresponding to the second logical pixel block (LB2) or not;

wherein the text judgment part (220) is adapted to determine that at least a portion of the data corresponding to the second logical pixel block (LB2) have the information of text when the maximum grayscale value is greater than the second predetermined value, and

wherein the text judgment part (220) is adapted to determine that the data corresponding to the second logical pixel block (LB2) do not have the information of text when the maximum grayscale value is less than the second predetermined value;

wherein the number of logical pixels (LB1) included in the first logical pixel block (LB1) is greater than 100×100;

wherein the number of the logical pixels (LP) which defines the second logical pixel block (LB2) is less than the number of the logical pixels (LP) which defines the first logical pixel block (LB1);

a line/edge detection part (230) adapted to receive the first text signal (SGN_T1) used to detect whether or not the data corresponds to a line or an edge with respect to the red, green and blue colors;

the line/edge detection part (230) adapted to analyze the data corresponding to the second logical pixel block (LB2) as the unit for analysis to detect whether or not the data corresponding to the second logical pixel block (LB2) corresponds to a line or an edge;

wherein the line/edge detection part (230) is adapted to provide a first detection signal (SGN_D1) to the data compensation part (250), when the data corresponding to the second logical pixel block (LB2) is detected as a line or an edge;

wherein the line/edge detection part (230) is adapted to provide a second detection signal (SGN_D2) to the data compensation part (250), when the data is detected as remainder; and

a color analysis part (240) adapted to receive the first text signal (SGN_T1) and to detect colors of the data corresponding to the second logical pixel block (LB2) and to provide an analysis signal (SGN_A) of the data for each of the red, green and blue data to the data compensation part (250) wherein the analysis signal (SGN_A) includes an analysis signal of a reference color and an analysis signal of remaining colors other than the reference color, wherein the color analysis part (240) being arranged to analyse the data corresponding to the second logical pixel block (LB2) with respect to the reference color settable to red, green or blue and wherein the high signal is generated when data of the reference color exists in the reference data and all of the adjacent data and wherein the low signal is generated when data of the reference color does not exist in the reference data and all of the adjacent data. wherein the data compensation part (250) is adapted not to compensate text data when all of the analysis signals (SGN_A) are the high signals or the low signals.

2. The data processing device (200) of claim 1, wherein the second logical pixel block (LB2) comprises 3 by 3 logical pixels (LP).

3. The data processing device (200) of claim 1, wherein each of the text judgment part (220), the line/edge detection part (230) and the color analysis part (240) are adapted to scan an entire of the data corresponding to the first logical pixel block (LB1) by moving the second logical pixel block (LB2) by a logical pixel row unit or a logical pixel column unit.

4. The data processing device (200) of claim 1, wherein the second logical pixel block (LB2) comprises a reference logical pixel (LP) and adjacent logical pixels

(LP) surrounding the reference logical pixel (LP), and the line/edge detection part (230) is adapted to detect data corresponding to the reference logical pixel (LP) as one of a line, an edge and a remainder with respect to each of red, green and blue colors.

5. The data processing device (200) of claim 1, wherein the second logical pixel block (LB2) comprises a reference logical pixel (LP) and adjacent logical pixels (LP) surrounding the reference logical pixel (LP), and the color analysis part (240) is adapted to generate an analysis signal of data corresponding to the reference logical pixel (LP) for each of the red, green and blue data, and provides the analysis data to the data compensation part (250).

6. The data processing device (200) of claim 1, wherein the data compensation part (250) is adapted to differently compensate text data having a first background color and text data having a second background color different from the first background color.

7. The data processing device (200) of claim 1, wherein optional color sub-pixel is a white sub-pixel.

Patentansprüche

1. Datenverarbeitungsvorrichtung (200), die dazu eingerichtet ist, Daten zu verarbeiten und einer Vielzahl von logischen Pixeln (LP) einer Anzeigevorrichtung (300) bereitzustellen, umfassend:

ein Datenanalyseteil (201), das zum Analysieren von Text-, Farb-, Zeilen- oder Randinformationen in jedem der Daten eingerichtet ist, und
ein Datenkompensationsteil (250), das dazu eingerichtet ist, wenigstens eines von Folgendem zu kompensieren: einen Rand oder eine Zeile von Text, der einem logischen Pixel (LP) entspricht, das keine Textfarbe anzeigt, weil die Textdaten unter den Daten die Textinformationen aufweisen, die auf den im Datenanalyseteil (201) analysierten Informationen beruhen, und das Daten, die keine Textinformationen aufweisen, nicht kompensiert,
wobei jedes der logischen Pixel (LP) der Anzeigevorrichtung (300) ein Pixel ist, das wenigstens eines von Folgendem umfasst: Unterpixel roter, grüner, blauer und optionaler Farbe, wobei das rote Unterpixel dazu eingerichtet ist, die Farbe Rot anzuzeigen, das grüne Unterpixel dazu eingerichtet ist, die Farbe Grün anzuzeigen, das blaue Unterpixel dazu eingerichtet ist, die Farbe Blau anzuzeigen, und das Unterpixel optionaler Farbe dazu eingerichtet ist, eine von Rot, Grün und Blau verschiedene Farbe anzuzeigen;
wobei das Datenanalyseteil (201) umfasst:
ein Histogrammanalyseteil (210), das dazu eingerichtet ist, die Daten entsprechend einem ersten logischen Pixelblock (LB1) zu analysieren, der durch wenigstens einen Teil der logischen Pixel (LP) definiert ist, um eine Textfarbe und eine Hintergrundfarbe eines in dem ersten logischen Pixelblock (LB1) anzuzeigenden Bildes zu bestimmen, wobei das Histogrammanalyseteil (210) eine Verteilung von Grauwerten jedes der roten, grünen und blauen Daten der dem ersten logischen Pixelblock (LB1) entsprechenden Daten analysiert, und
wenn zwei oder mehr der roten, grünen und blauen Daten einen Grauwert größer als ein erster vorbestimmter Wert aufweisen, erkennt das Histogrammanalyseteil (210) eine Farbe mit dem kleinsten Verteilungsvolumen unter den Farben der roten, grünen und blauen Daten als Textfarbe und erkennt eine verbleibende Farbe unter den Farben der roten, grünen und blauen Daten als Hintergrundfarbe,
ein Textbeurteilungsteil (220), das dazu eingerichtet ist, die Daten entsprechend einem zweiten logischen Pixelblock (LB2) zu analysieren, der im ersten logischen Pixelblock (LB1) enthalten ist, wobei das Textbeurteilungsteil (220) eine Analyseeinheit ist, die erkennt, ob die dem zweiten logischen Pixelblock (LB2) entsprechenden Daten die Textinformationen enthalten oder nicht, und dazu eingerichtet ist, ein erstes Textsignal (SGN_T1) auszugeben, wenn die dem zweiten logischen Pixelblock (LB2) entsprechenden Daten Textinformationen enthalten, sowie dazu eingerichtet ist, ein zweites Textsignal (SGN_T2) an das Datenkompensationsteil (250) auszugeben, wenn dem zweiten logischen Pixelblock (LB2) entsprechende Daten keine Textinformationen enthalten;
wobei die logischen Pixel (LP) des ersten logischen Pixelblocks (LB1) aneinander angrenzend angeordnet sind und wobei die logischen Pixel (LP) des zweiten logischen Pixelblocks (LB2) aneinander angrenzend angeordnet sind;
wobei das Textbeurteilungsteil (220) dazu eingerichtet ist, einen maximalen Grauwert der roten, grünen und blauen Daten der dem zweiten logischen Pixelblock (LB2) entsprechenden Daten mit einem zweiten vorbestimmten Wert zu vergleichen, um zu erkennen, ob in den dem zweiten logischen Pixelblock (LB2) entsprechenden Daten die Textinformationen vorliegen oder nicht;
wobei das Textbeurteilungsteil (220) dazu

eingerichtet ist, festzustellen, dass wenigstens ein Teil der dem zweiten logischen Pixelblock (LB2) entsprechenden Daten die Textinformationen aufweist, wenn der maximale Grauwert größer als der zweite vorbestimmte Wert ist, und
wobei das Textbeurteilungsteil (220) dazu eingerichtet ist, festzustellen, dass die dem zweiten logischen Pixelblock (LB2) entsprechenden Daten die Textinformationen nicht aufweisen, wenn der maximale Grauwert kleiner als der zweite vorbestimmte Wert ist,

wobei die Anzahl in dem ersten logischen Pixelblock (LB1) enthaltener logischer Pixel (LB1) größer als 100 x 100 ist;
wobei die Anzahl der logischen Pixel (LP), die den zweiten logischen Pixelblock (LB2) definiert, kleiner als die Anzahl der logischen Pixel (LP) ist, die den ersten logischen Pixelblock (LB1) definiert;
ein Zeilen/Rand-Erkennungsteil (230), das zum Empfangen des ersten Textsignals (SGN_T1) eingerichtet ist, das dazu verwendet wird, zu erkennen, ob die Daten einer Zeile oder einem Rand bezüglich der roten, grünen und blauen Farben entsprechen oder nicht;
wobei das Zeilen/Rand-Erkennungsteil (230) dazu eingerichtet ist, die dem zweiten logischen Pixelblock (LB2) entsprechenden Daten als Analyseeinheit zu analysieren, um zu erkennen, ob die dem zweiten logischen Pixelblock (LB2) entsprechenden Daten einer Zeile oder einem Rand entsprechen oder nicht;
wobei das Zeilen/Rand-Erkennungsteil (230) dazu eingerichtet ist, ein erstes Detektionssignal (SGN_D1) an dem Datenkompensationsteil (250) bereitzustellen, wenn die dem zweiten logischen Pixelblock (LB2) entsprechenden Daten als Zeile oder Rand erkannt werden;
wobei das Zeilen/Rand-Erkennungsteil (230) dazu eingerichtet ist, ein zweites Detektionssignal (SGN_D2) an dem Datenkompensationsteil (250) bereitzustellen, wenn die Daten als Rest erkannt werden, und
ein Farbanalyseteil (240), das dazu eingerichtet ist, das erste Textsignal (SGN_T1) zu empfangen und Farben der Daten zu erkennen, die dem zweiten logischen Pixelblock (LB2) entsprechen, und
ein Analysesignal (SGN_A) der Daten für jedes der roten, grünen und blauen Daten an dem Datenkompensationsteil (250) bereitzustellen, wobei das Analysesignal (SGN_A) ein Analysesignal einer Referenzfarbe und ein Analysesignal sonstiger Farben, bei denen es sich nicht um die Referenzfarbe handelt, enthält, wobei das Farbanalyseteil (240) dazu eingerichtet ist, die dem zweiten logischen Pixelblock (LB2) entsprechenden Daten bezüglich der Referenzfarbe, die auf Rot, Grün oder Blau eingestellt werden kann, zu analysieren, und wobei das starke Signal erzeugt wird, wenn Daten der Referenzfarbe in den Referenzdaten und allen angrenzenden Daten vorliegen,
und wobei das schwache Signal erzeugt wird, wenn keine Daten der Referenzfarbe in den Referenzdaten und allen angrenzenden Daten vorliegen, wobei das Datenkompensationsteil (250) dazu eingerichtet ist, Textdaten nicht zu kompensieren, wenn alle Analysesignale (SGN_A) die starken Signale oder die schwachen Signale sind.

2. Datenverarbeitungsvorrichtung (200) nach Anspruch 1, wobei der zweite logische Pixelblock (LB2) 3 mal 3 logische Pixel (LP) umfasst.

3. Datenverarbeitungsvorrichtung (200) nach Anspruch 1, wobei
das Textbeurteilungsteil (220), das Zeilen/Rand-Erkennungsteil (230) und das Farbanalyseteil (240) jeweils dazu eingerichtet sind, die gesamten dem ersten logischen Pixelblock (LB1) entsprechenden Daten abzutasten, indem der zweite logische Pixelblock (LB2) um eine logische Pixel-Reiheneinheit oder eine logische Pixel-Spalteneinheit verschoben wird.

4. Datenverarbeitungsvorrichtung (200) nach Anspruch 1, wobei
der zweite logische Pixelblock (LB2) ein logisches Referenzpixel (LP) und angrenzende logische Pixel (LP), welche das logische Referenzpixel (LP) umgeben, umfasst, und
das Zeilen/Rand-Erkennungsteil (230) dazu eingerichtet ist, Daten, die dem logischen Referenzpixel (LP) entsprechen, als eine Zeile, einen Rand und einen Rest bezüglich der Farben Rot, Grün und Blau zu erkennen.

5. Datenverarbeitungsvorrichtung (200) nach Anspruch 1, wobei
der zweite logische Pixelblock (LB2) ein logisches Referenzpixel (LP) und angrenzende logische Pixel (LP), welche das logische Referenzpixel (LP) umgeben, umfasst, und
das Farbanalyseteil (240) dazu eingerichtet ist, ein Analysesignal für Daten entsprechend dem logischen Referenzpixel (LP) für jedes der roten, grünen und blauen Daten zu erzeugen, und die Analysedaten an dem Datenkompensationsteil (250) bereitstellt.

6. Datenverarbeitungsvorrichtung (200) nach An-

spruch 1, wobei
das Datenkompensationsteil (250) dazu eingerichtet ist, Textdaten mit einer ersten Hintergrundfarbe und Textdaten mit einer zweiten Hintergrundfarbe, die sich von der ersten Hintergrundfarbe unterscheidet, unterschiedlich zu kompensieren.

7. Datenverarbeitungsvorrichtung (200) nach Anspruch 1, wobei ein Unterpixel mit optionaler Farbe ein weißes Unterpixel ist.

Revendications

1. Dispositif de traitement de données (200) adapté pour traiter des données et les fournir à de multiples pixels logiques (LP) d'un dispositif d'affichage (300), comprenant :

une partie d'analyse de données (201) adaptée pour analyser des informations de texte, couleur, ligne ou bord dans chacune des données ; et
une partie de compensation de données (250) adaptée pour compenser au moins une donnée de bord ou de ligne ou de texte correspondant à un pixel logique (LP) qui n'affiche pas une couleur du texte à cause des données de texte parmi les données qui comportent l'information de texte sur la base des informations analysées dans la partie d'analyse de données (201), et qui ne compense pas les données qui n'ont pas d'information de texte,
chacun des pixels logiques (LP) du dispositif d'affichage (300) étant un pixel qui comprend au moins un sous-pixel parmi des sous-pixels rouge, vert, bleu et de couleur optionnelle, le sous-pixel rouge étant adapté pour afficher la couleur rouge, le sous-pixel vert adapté pour afficher la couleur verte, le sous-pixel bleu adapté pour afficher la couleur bleue et le sous-pixel de couleur optionnelle adapté pour afficher une couleur différente du rouge, du vert et du bleu ;
la partie d'analyse de données (201) comprenant :

une partie d'analyse d'histogramme (210) adaptée pour analyser les données correspondant à un premier bloc de pixels logiques (LB1) qui est défini par au moins une partie des pixels logiques (LP), afin de déterminer une couleur de texte et une couleur de fond d'une image à afficher dans le premier bloc de pixels logiques (LB1), la partie d'analyse d'histogramme (210) analysant une distribution d'échelle de gris de chacune des données de rouge, vert et bleu des données correspondant au premier bloc de pixels logiques (LB1) et la partie d'analyse d'histogramme (210) détectant, quand deux ou plusieurs des données de rouge, vert et bleu ont une valeur d'échelle de gris supérieure à une première valeur prédéterminée, une couleur ayant le plus petit volume de distribution parmi les douleurs des données de rouge, vert et bleu comme couleur de texte et détectant une couleur restante des couleurs des données de rouge, vert et bleu comme une couleur de fond,
une partie d'évaluation de texte (220) adaptée pour analyser les données correspondant à un deuxième bloc de pixels logiques (LB2) inclus dans le premier bloc de pixels logiques (LB1), la partie d'évaluation de texte (220) étant une unité d'analyse destinée à détecter si les données correspondant au deuxième bloc de pixels logiques (LB2) incluent ou non les informations de texte et adaptée pour émettre en sortie un premier signal de texte (SGN_T1) quand les données correspondant au deuxième bloc de pixels logiques (LB2) incluent des informations de texte, et adaptée pour émettre en sortie un deuxième signal de texte (SGN_T2) vers la partie de compensation de données (250) quand les données correspondant au deuxième bloc de pixels logiques (LB2) n'incluent pas d'informations de texte ;
les pixels logiques (LP) du premier bloc de pixels logiques (LB1) étant adjacents les uns aux autres et les pixels logiques (LP) du deuxième bloc de pixels logiques (LB2) étant adjacents les uns aux autres ;
la partie d'évaluation de texte (220) étant adaptée pour comparer une valeur maximale d'échelle de gris des données de rouge, vert et bleu des données correspondant au deuxième bloc de pixels logiques (LB2) à une deuxième valeur prédéterminée pour détecter si les informations de texte existent ou non dans les données correspondant au deuxième bloc de pixels logiques (LB2) ;
la partie d'évaluation de texte (220) étant adaptée pour déterminer si au moins une partie des données correspondant au deuxième bloc de pixels logiques (LB2) contiennent les informations de texte quand la valeur maximale d'échelle de gris est supérieure à la deuxième valeur prédéterminée, et
la partie d'évaluation de texte (220) étant adaptée pour déterminer que les données correspondant au deuxième bloc de pixels logiques (LB2) ne contiennent pas les informations de texte quand la valeur maximale

d'échelle de gris est inférieure à la deuxième valeur prédéterminée ;

le nombre de pixels logiques (LB1) inclus dans le premier bloc de pixels logiques (LB1) étant supérieur à 100 x 100 ;
le nombre de pixels logiques (LP) qui définit le deuxième bloc de pixels logiques (LB2) étant inférieur au nombre des pixels logiques (LP) qui définit le premier bloc de pixels logiques (LB1) ;
une partie de détection de lignes ou de bords (230) adaptée pour recevoir le premier signal de texte (SGN_T1) utilisé pour détecter si les données correspondent ou non à une ligne ou un bord par rapport aux couleurs rouge, verte et bleue ;
la partie de détection de lignes ou de bords (230) étant adaptée pour analyser les données correspondant au deuxième bloc de pixels logiques (LB2) en tant qu'unité d'analyse servant à détecter si les données correspondant au deuxième bloc de pixels logiques (LB2) correspondent ou non à une ligne ou un bord ;
la partie de détection de lignes ou de bords (230) étant adaptée pour fournir un premier signal de détection (SGN_D1) à la partie de compensation de données (250) quand les données correspondant au deuxième bloc de pixels logiques (LB2) sont détectées comme une ligne ou un bord ;
la partie de détection de lignes ou de bords (230) étant adaptée pour fournir un deuxième signal de détection (SGN_D2) à la partie de compensation de données (250) quand les données sont détectées comme le restant ; et
une partie d'analyse des couleurs (240) adaptée pour recevoir le premier signal de texte (SGN_T1) et pour détecter les couleurs des données correspondant au deuxième bloc de pixels logiques (LB2) et pour fournir un signal d'analyse (SGN_A) des données pour chacune des données de rouge, vert et
bleu à la partie de compensation de données (250), le signal d'analyse (SGN_A) incluant un signal d'analyse d'une couleur de référence et un signal d'analyse des couleurs restantes autres que la couleur de référence, la partie d'analyse des couleurs (240) étant disposée pour analyser les données correspondant au deuxième bloc de pixels logiques (LB2) par rapport à la couleur de référence qui peut être réglée au rouge, au bleu ou au vert, et le signal haut étant généré quand les données de la couleur de référence existent dans les données de référence et toutes les données adjacentes et le signal bas étant généré quand les données de la couleur de référence n'existent pas dans les données de référence ni toutes les données adjacentes,
la partie de compensation de données (250) étant adaptée pour ne pas compenser les données de texte quand tous les signaux d'analyse (SGN_A) sont des signaux hauts ou des signaux bas.

2. Dispositif de traitement de données (200) selon la revendication 1, dans lequel le deuxième bloc de pixels logiques (LB2) comprend 3 par 3 pixels logiques (LP).

3. Dispositif de traitement de données (200) selon la revendication 1, dans lequel la partie d'évaluation de texte (220), la partie de détection de lignes ou de bords (230) et la partie d'analyse des couleurs (240) sont adaptées chacune pour balayer l'ensemble des données correspondant au premier bloc de pixels logiques (LB1) en déplaçant le deuxième bloc de pixels logiques (LB2) d'une unité de ligne de pixels logiques ou d'une unité de colonne de pixels logiques.

4. Dispositif de traitement de données (200) selon la revendication 1, dans lequel le deuxième bloc de pixels logiques (LB2) comprend un pixel logique de référence (LP) et des pixels logiques adjacents (LP) entourant le pixel logique de référence (LP), et
la partie de détection de lignes ou de bords (230) est adaptée pour détecter des données correspondant au pixel logique de référence (LP) comme étant soit une ligne ou un bord, soit un restant par rapport à chacune des couleurs rouge, verte et bleue.

5. Dispositif de traitement de données (200) selon la revendication 1, dans lequel le deuxième bloc de pixels logiques (LB2) comprend un pixel logique de référence (LP) et des pixels logiques adjacents (LP) entourant le pixel logique de référence (LP), et la partie d'analyse des couleurs (240) est adaptée pour générer un signal d'analyse de données correspondant au pixel logique de référence (LP) pour chacune des données de rouge, vert et bleu et fournir les données d'analyse à la partie de compensation de données (250).

6. Dispositif de traitement de données (200) selon la revendication 1, dans lequel la partie de compensation de données (250) est adaptée pour compenser différemment des données de texte ayant une première couleur de fond et des données de texte ayant une deuxième couleur de fond différente de la première couleur de fond.

7. Dispositif de traitement de données (200) selon la revendication 1, dans lequel le sous-pixel de couleur optionnelle est un sous-pixel blanc.

Fig. 1

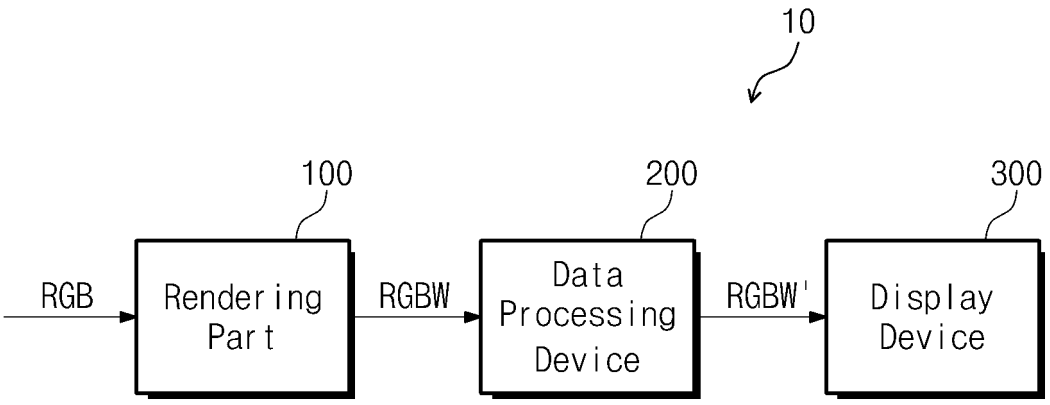

10
100
200
300
RGB
Rendering Part
RGBW
Data Processing Device
RGBW'
Display Device

Fig. 2

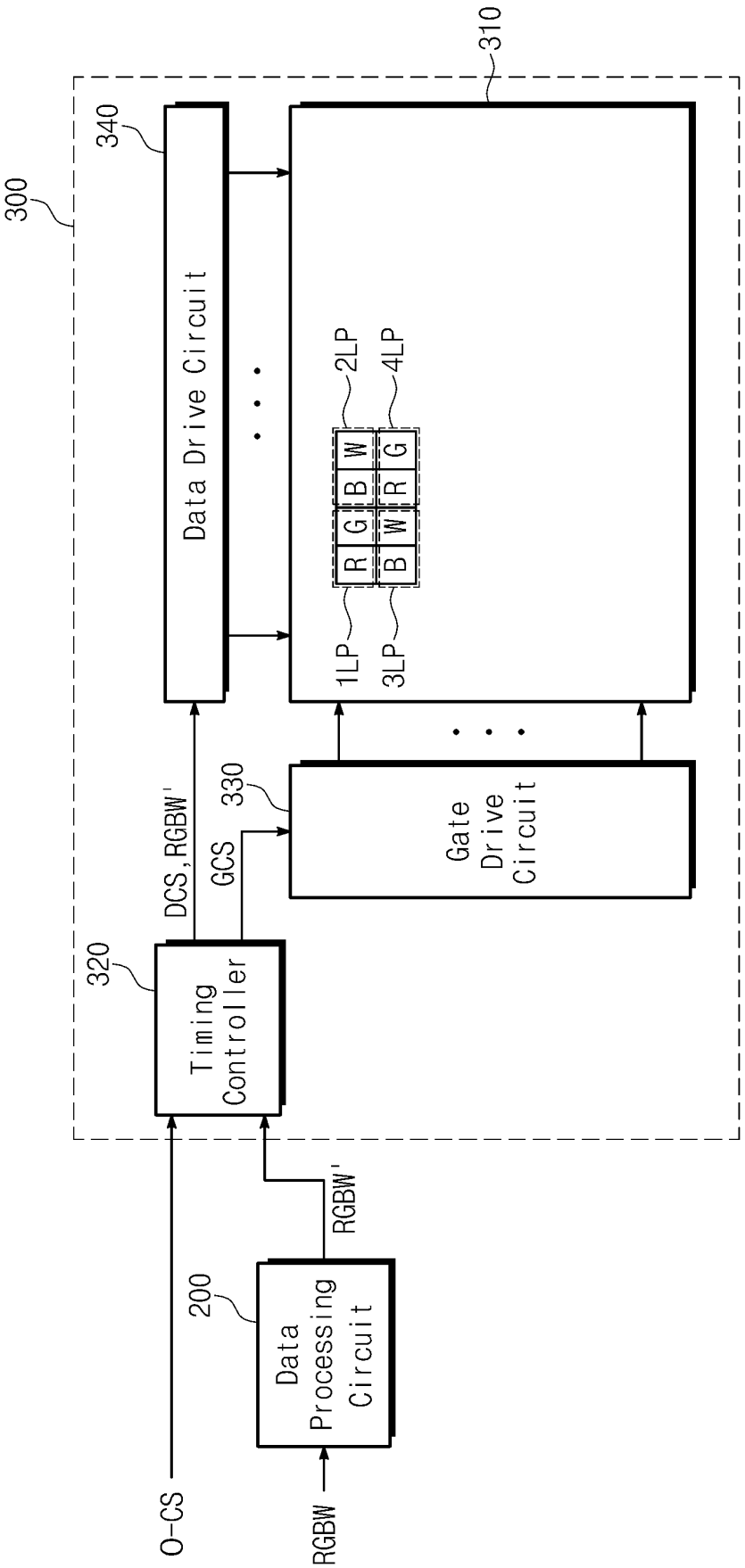

300
310
340
Data Drive Circuit
2LP
4LP
R G B W
B W R G
1LP
3LP
330
Gate Drive Circuit
DCS,RGBW'
GCS
320
Timing Controller
O-CS
200
Data Processing Circuit
RGBW'
RGBW

Fig. 3

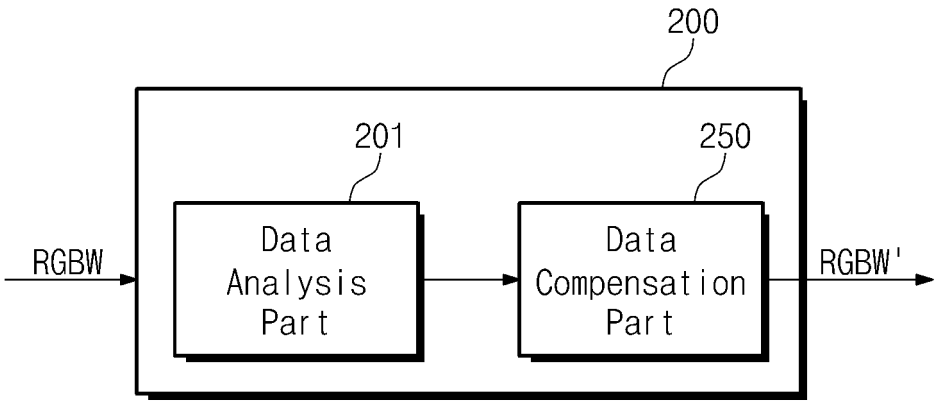

200
201
250
RGBW
Data Analysis Part
Data Compensation Part
RGBW'

Fig. 4

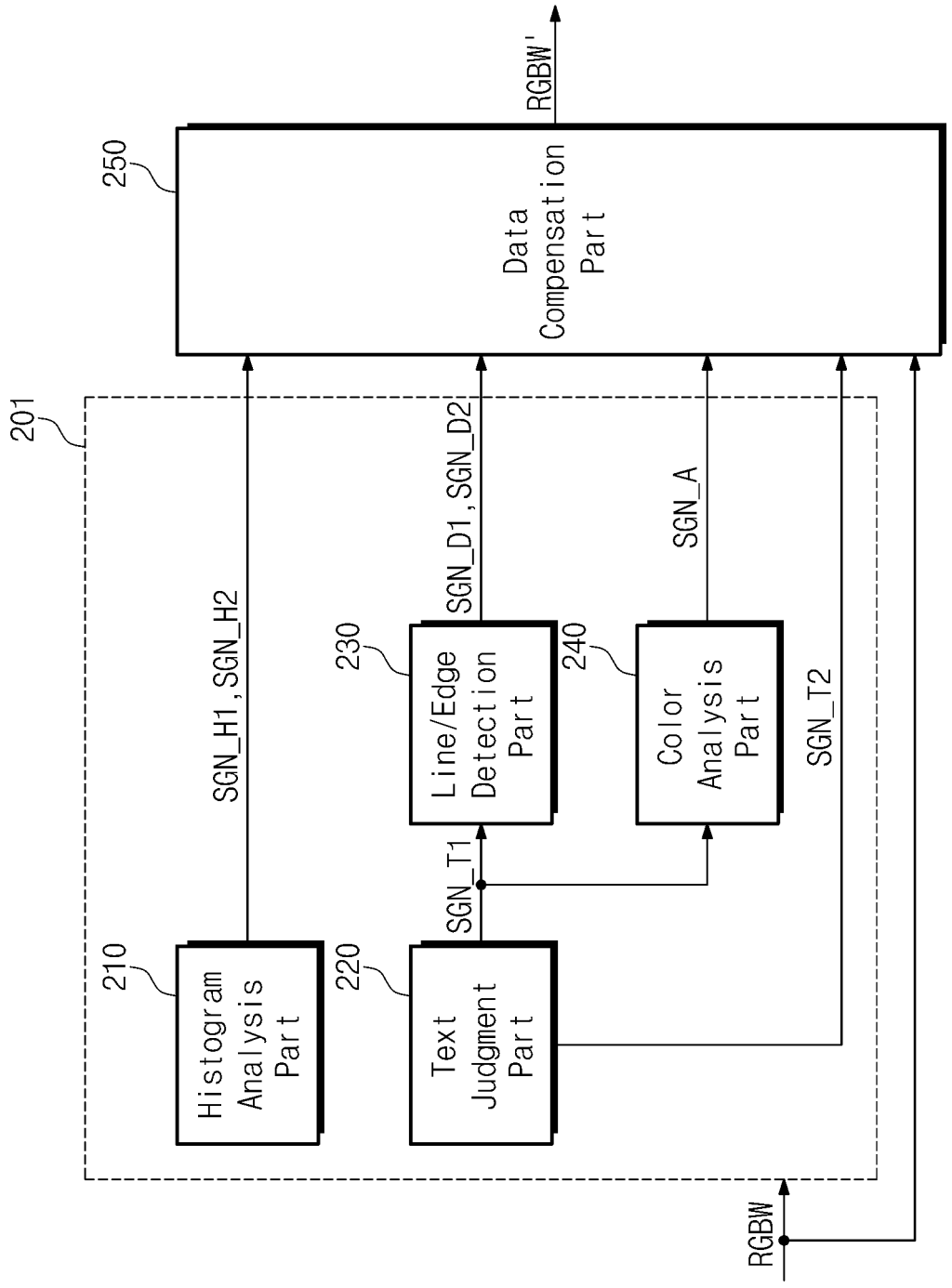

RGBW'
250
Data Compensation Part
201
SGN_H1, SGN_H2
SGN_D1, SGN_D2
SGN_A
230
Line/Edge Detection Part
240
Color Analysis Part
SGN_T2
SGN_T1
210
Histogram Analysis Part
220
Text Judgment Part
RGBW

Fig. 5

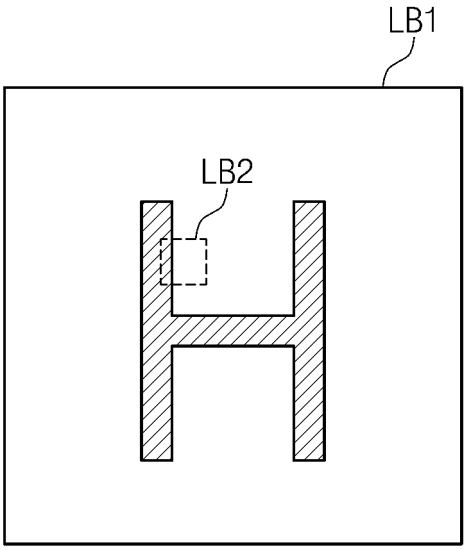


Fig. 6

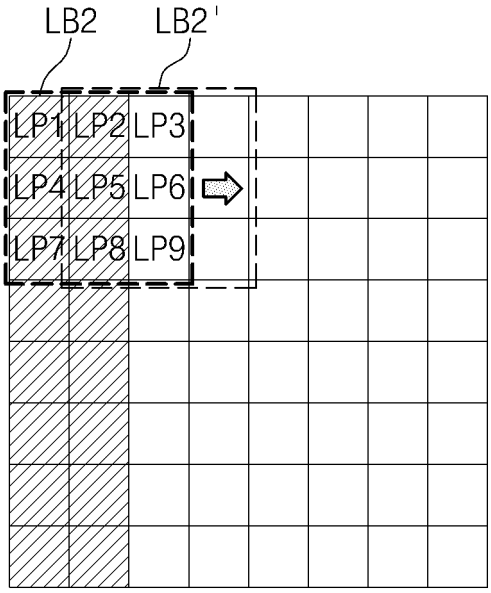


Fig. 7

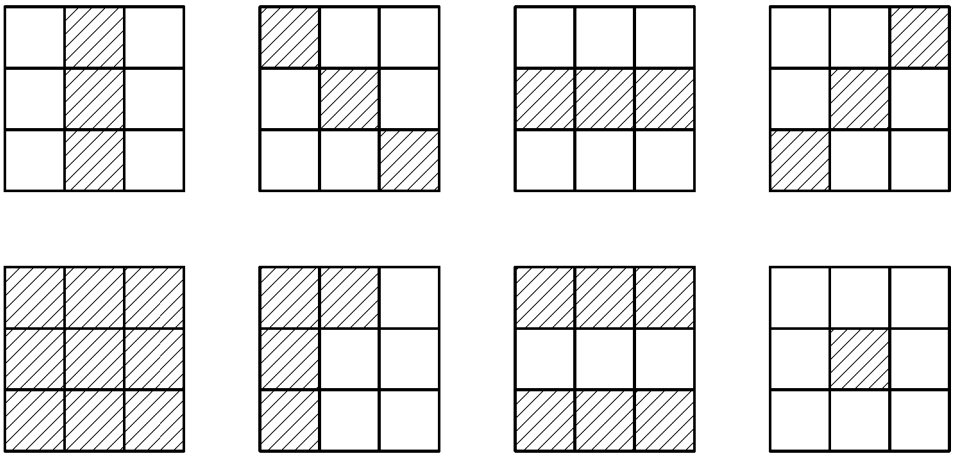


Fig. 8

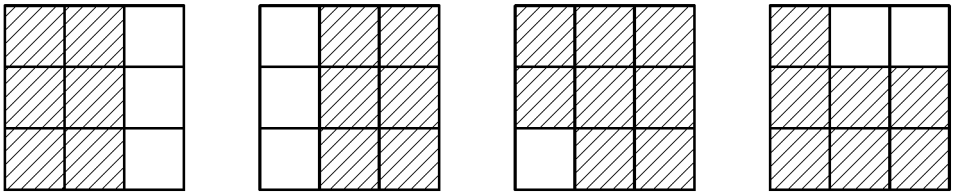


Fig. 9

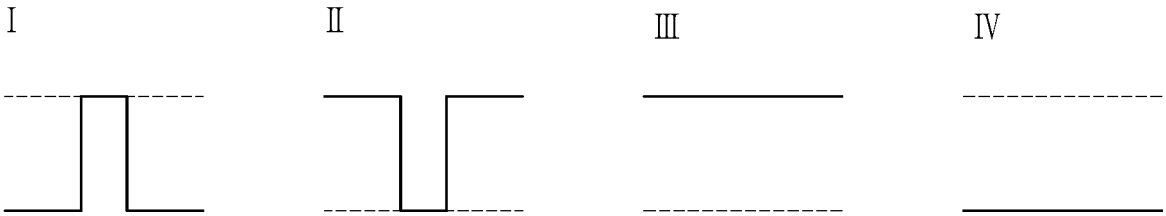


Fig. 10

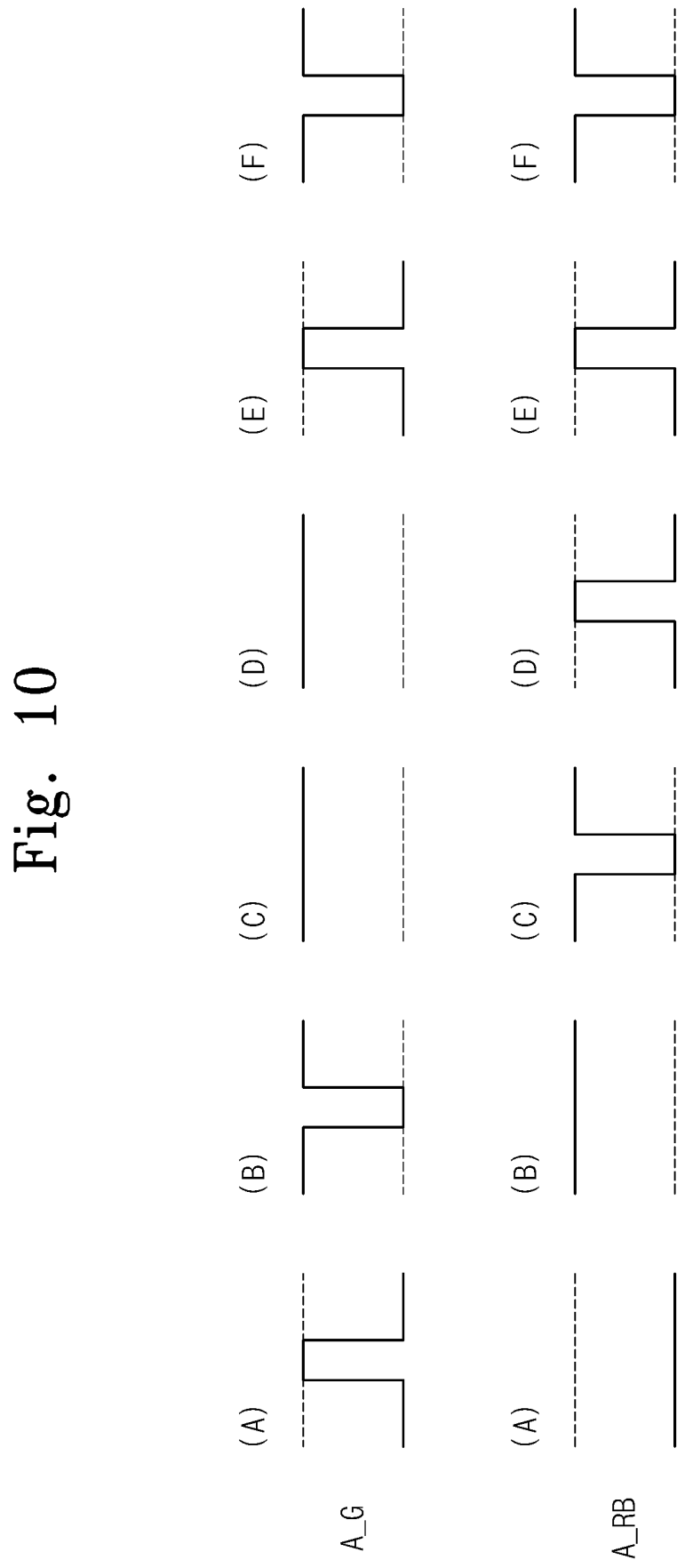


Fig. 11A

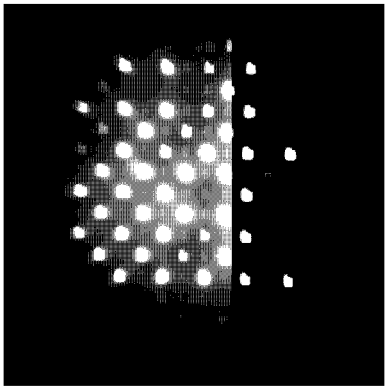


Fig. 11B

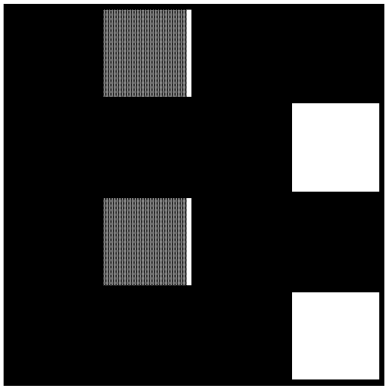


Fig. 12A

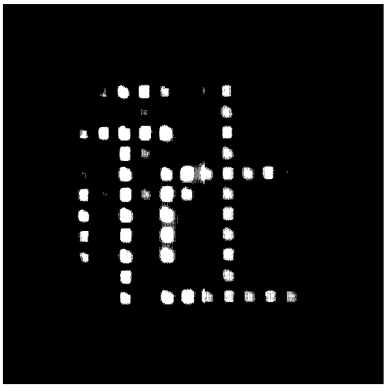


Fig. 12B

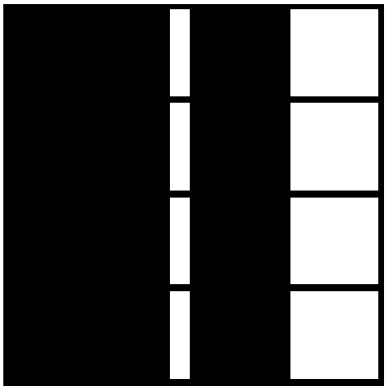


Fig. 13

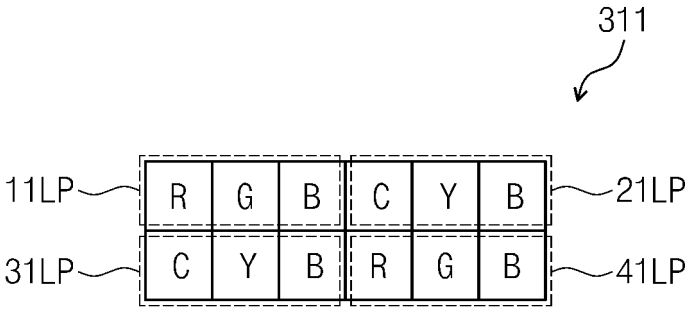

311
11LP
R
G
B
C
Y
B
21LP
31LP
C
Y
B
R
G
B
41LP

Fig. 14

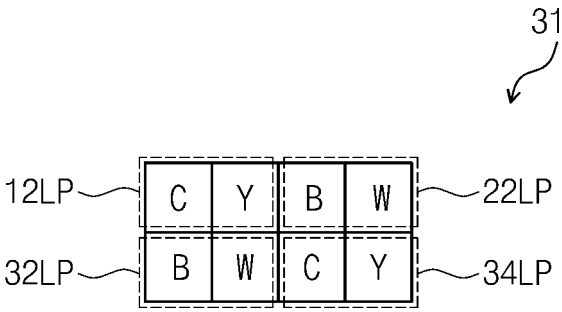

312
12LP
C
Y
B
W
22LP
32LP
B
W
C
Y
34LP

Fig. 15

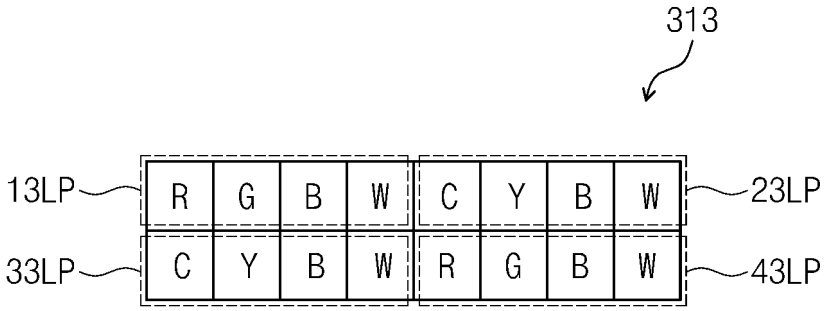

313
13LP
R G B W C Y B W
23LP
33LP
C Y B W R G B W
43LP

Fig. 16

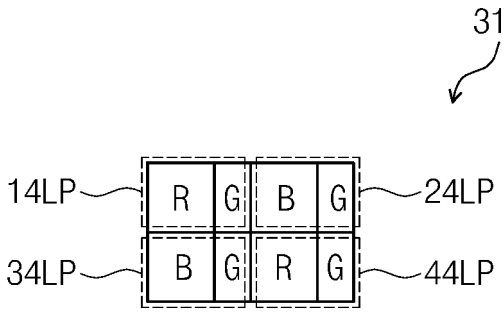

314
14LP
R G B G
24LP
34LP
B G R G
44LP

Fig. 17

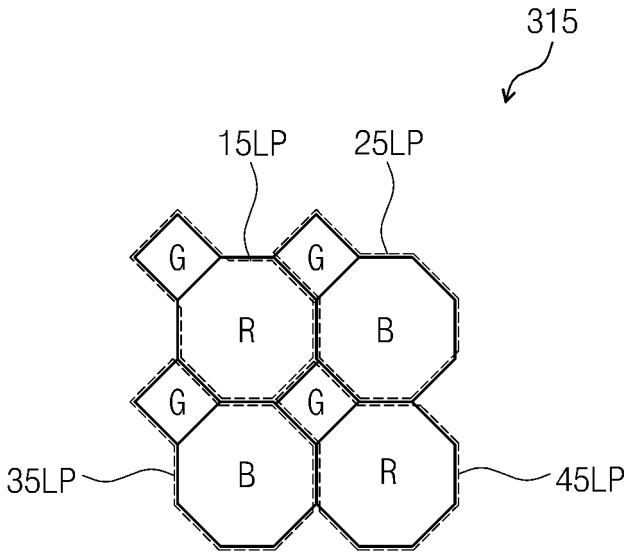
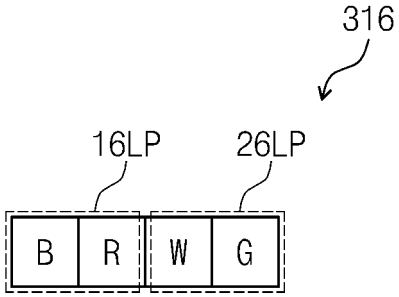


Fig. 18



REFERENCES CITED IN THE DESCRIPTION

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