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(54) COMPENSATION HARDWARE DEVICE FOR NON-UNIFORM REGIONS IN FLAT PANEL DISPLAY

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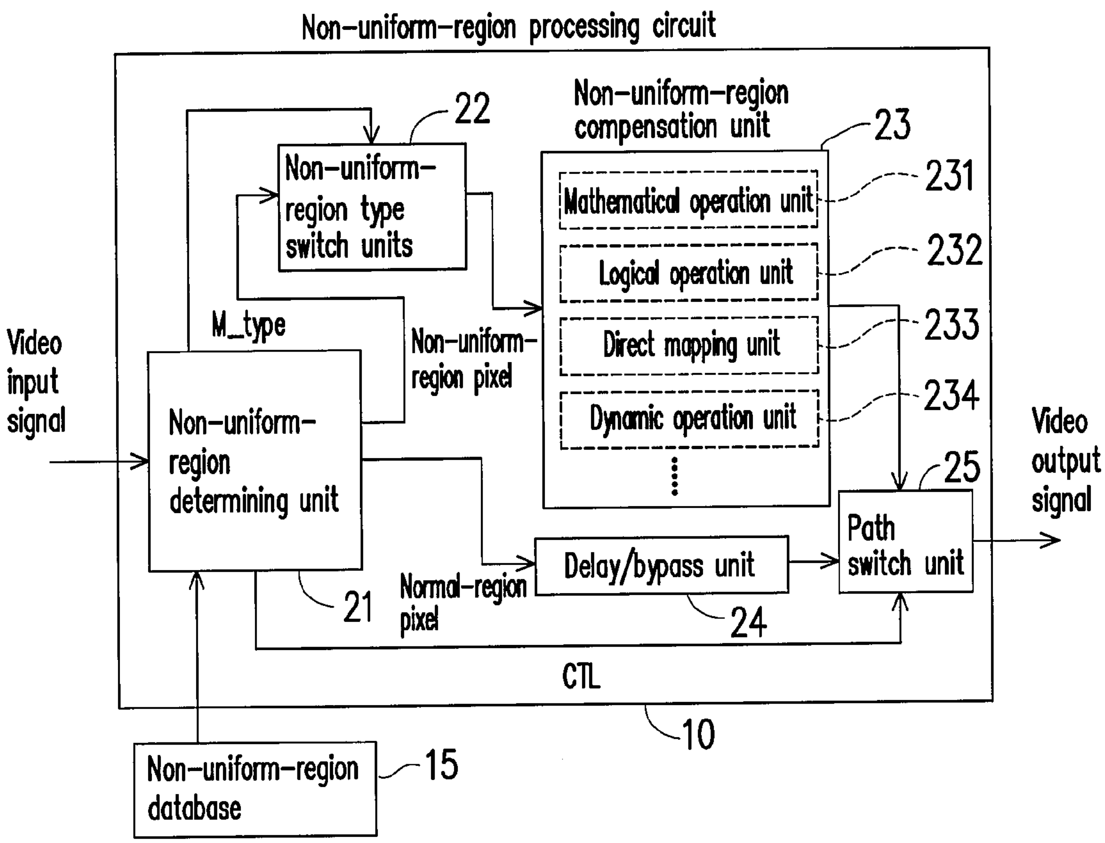
(57) **ABSTRACT**

The present invention discloses a compensation hardware device for non-uniform regions in a flat panel display. The hardware device processes the flat panel display having non-uniform regions through digital signal processing, instead of by using materials, optical films or fabrication processes. Therefore, the manufacturing cost and complexity of the flat panel display are not negatively affected. In the digital signal processing architecture, a non-uniform-region compensation unit is used to process a video signal falling in a non-uniform region pixel, such that the non-uniform regions may not negatively affect the video signal displayed on the panel.



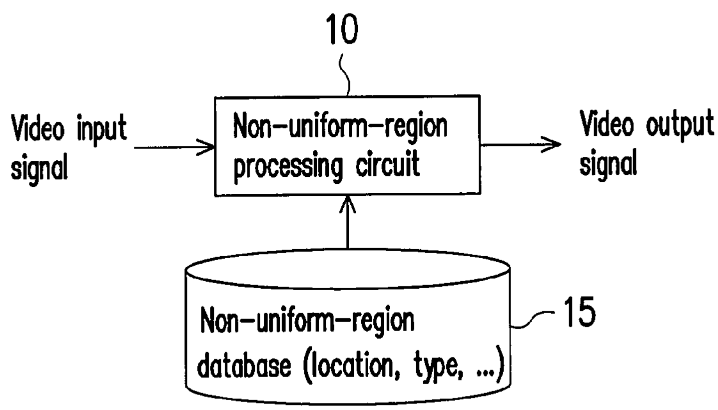

10
Video input signal
Non-uniform-region processing circuit
Video output signal
Non-uniform-region database (location, type, ...)
15

FIG. 1

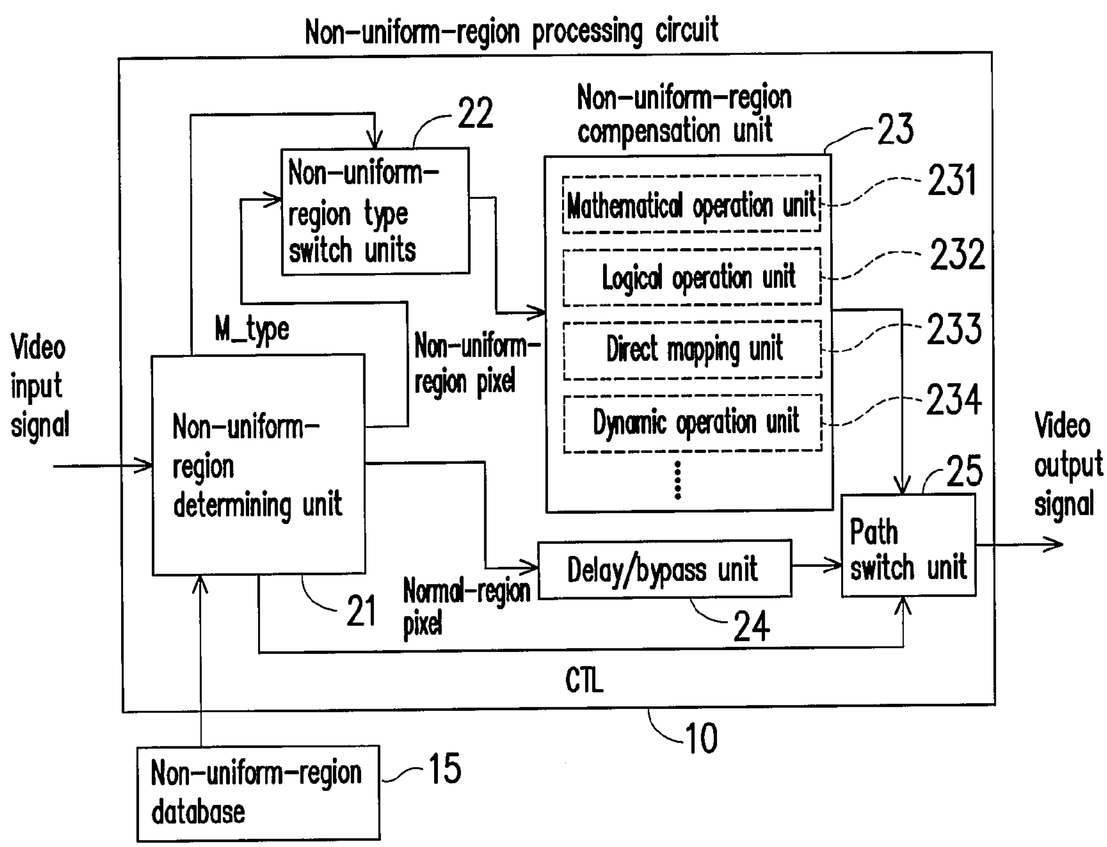

Non-uniform-region processing circuit
22
Non-uniform-region type switch units
Non-uniform-region compensation unit
23
Mathematical operation unit
231
Logical operation unit
232
Direct mapping unit
233
Dynamic operation unit
234
M_type
Non-uniform-region pixel
Video input signal
Non-uniform-region determining unit
21
Normal-region pixel
Delay/bypass unit
24
25
Path switch unit
Video output signal
CTL
10
Non-uniform-region database
15

FIG. 2

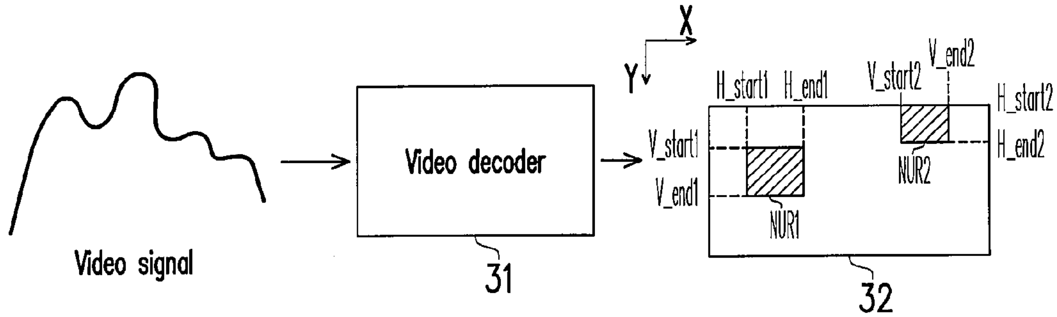

Video signal
Video decoder
31
X
Y
H_start1
H_end1
V_start2
V_end2
H_start2
H_end2
V_start1
V_end1
NUR1
NUR2
32

FIG. 3

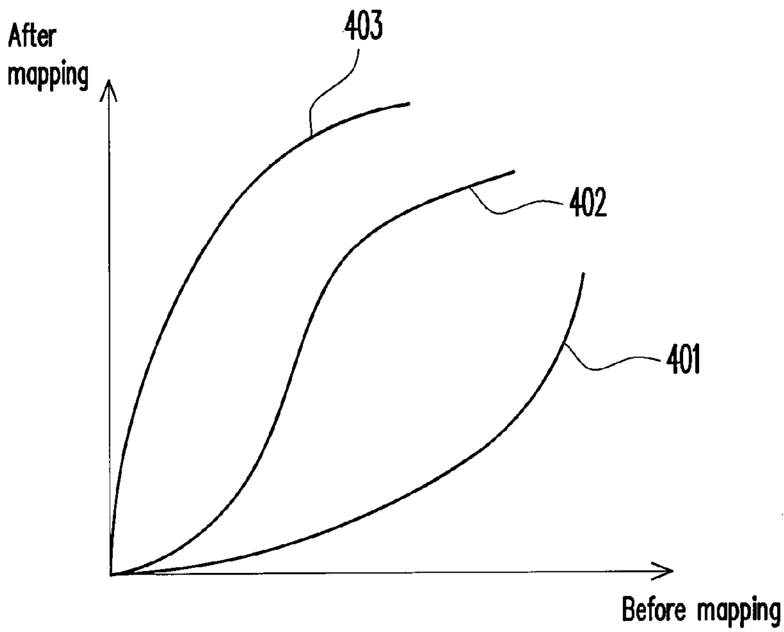

After mapping
403
402
401
Before mapping

FIG. 4

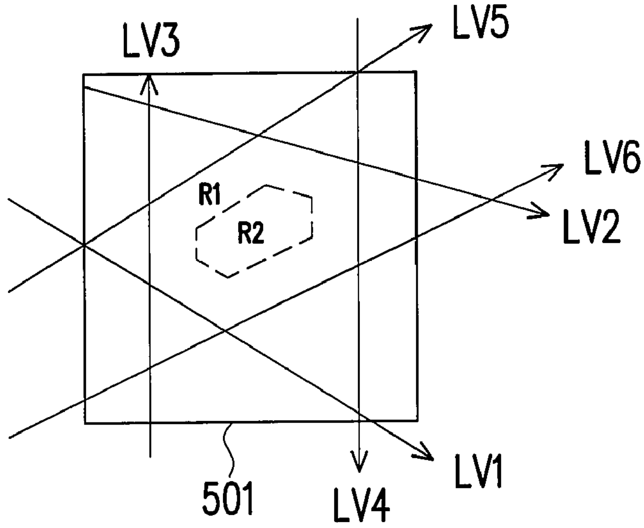


FIG. 5A

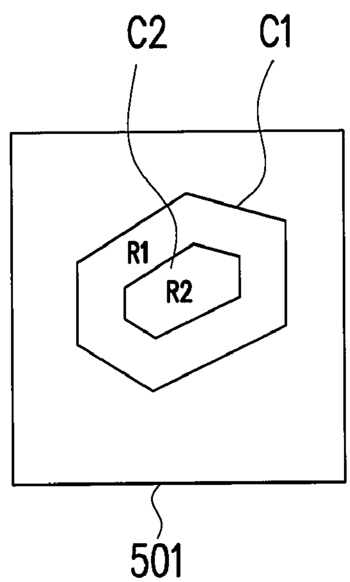


FIG. 5B

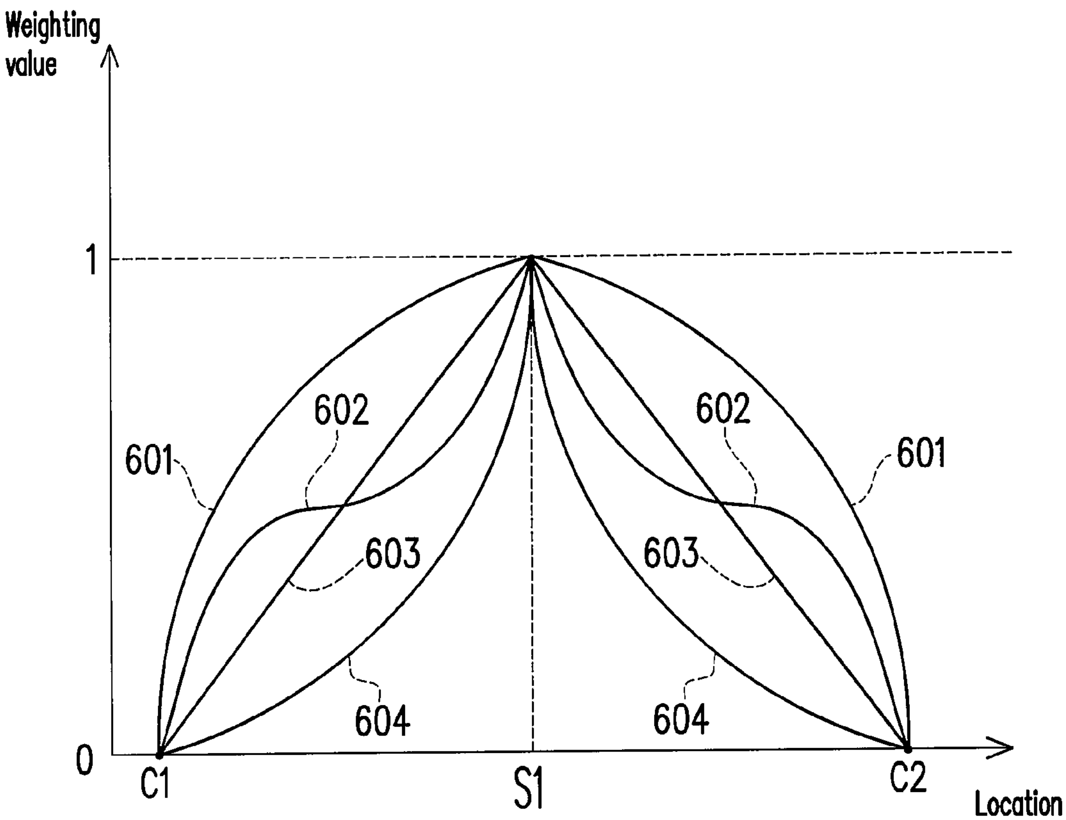

Weighting value
1
0
601
602
603
604
602
601
603
604
C1
S1
C2
Location

FIG. 6A

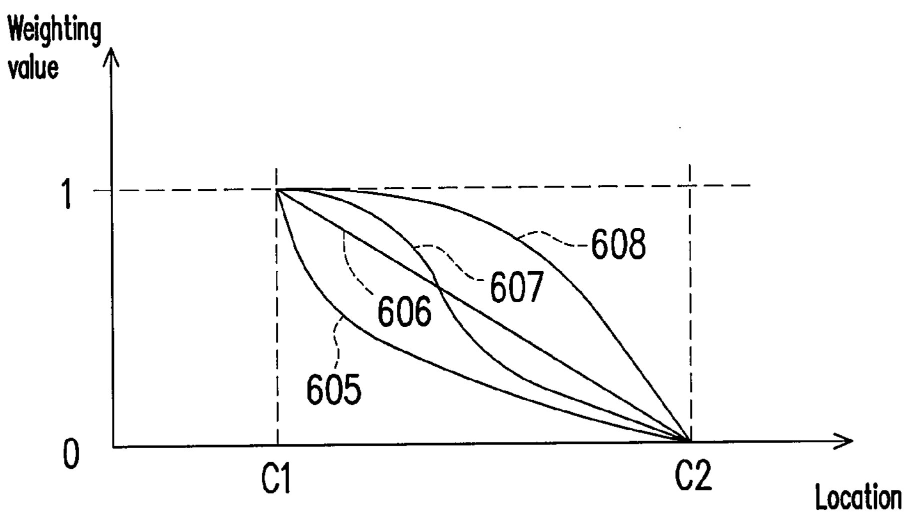

Weighting value
1
0
608
607
606
605
C1
C2
Location

FIG. 6B

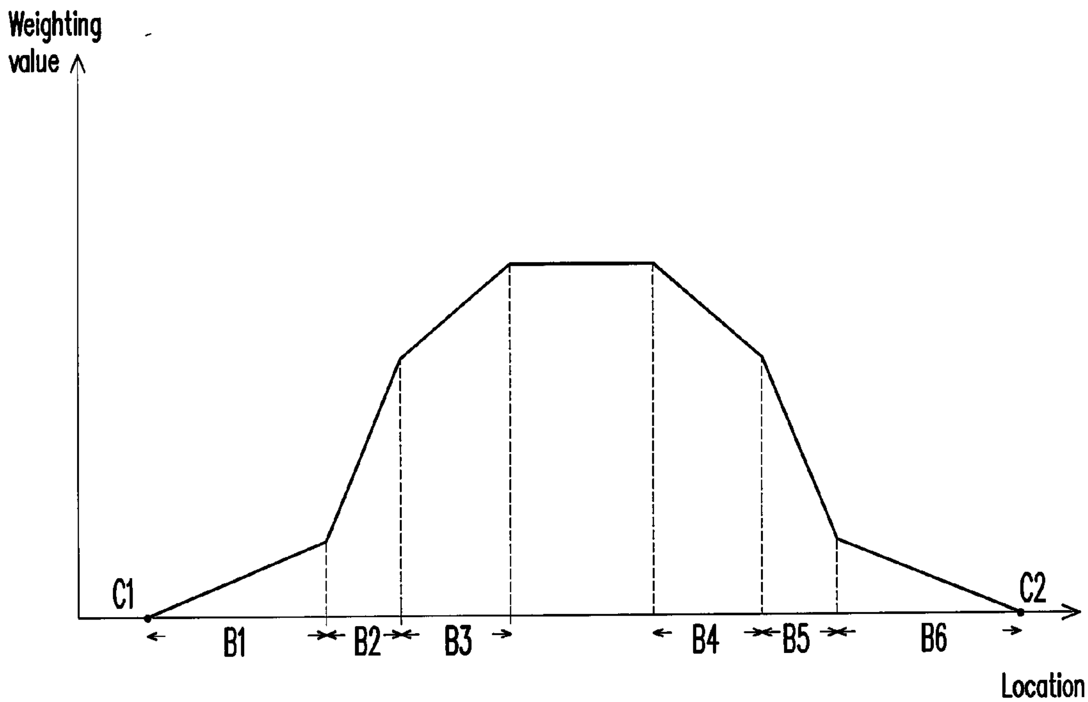


FIG. 6C

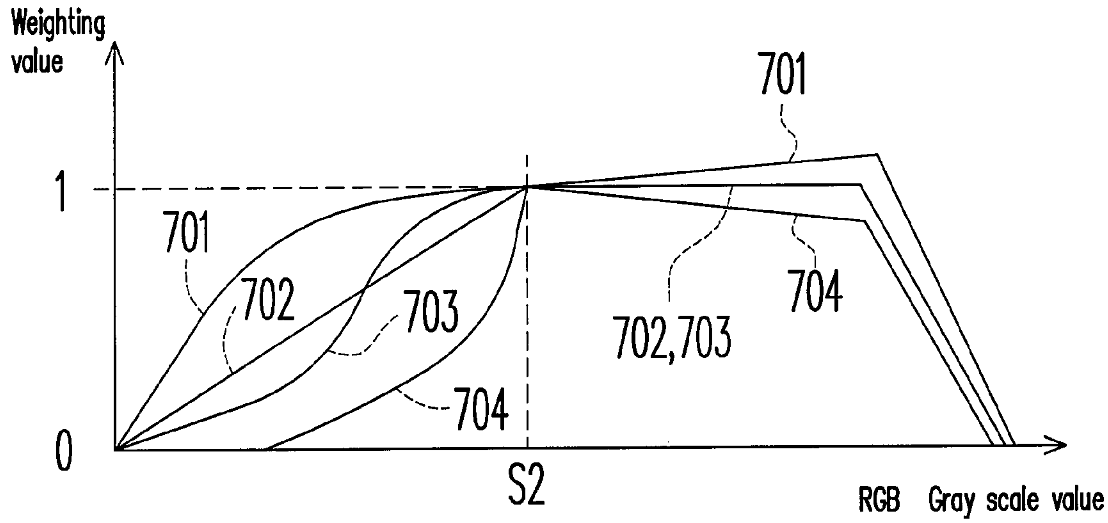

Weighting value
701
1
701
702
703
704
702,703
704
0
S2
RGB Gray scale value

FIG. 7

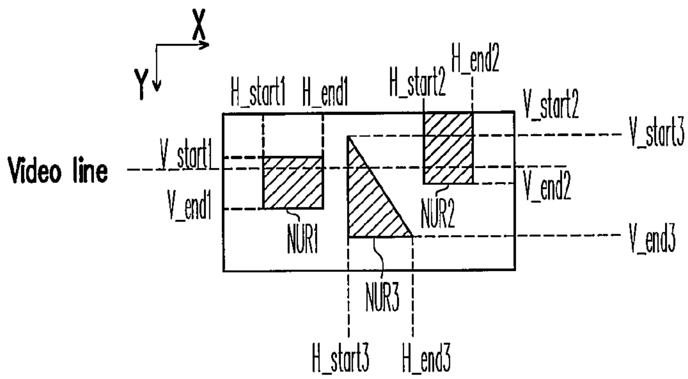

X
Y
H_start1
H_end1
H_start2
H_end2
V_start2
V_start3
Video line
V_start1
V_end1
V_end2
NUR1
NUR2
V_end3
NUR3
H_start3
H_end3

FIG. 8

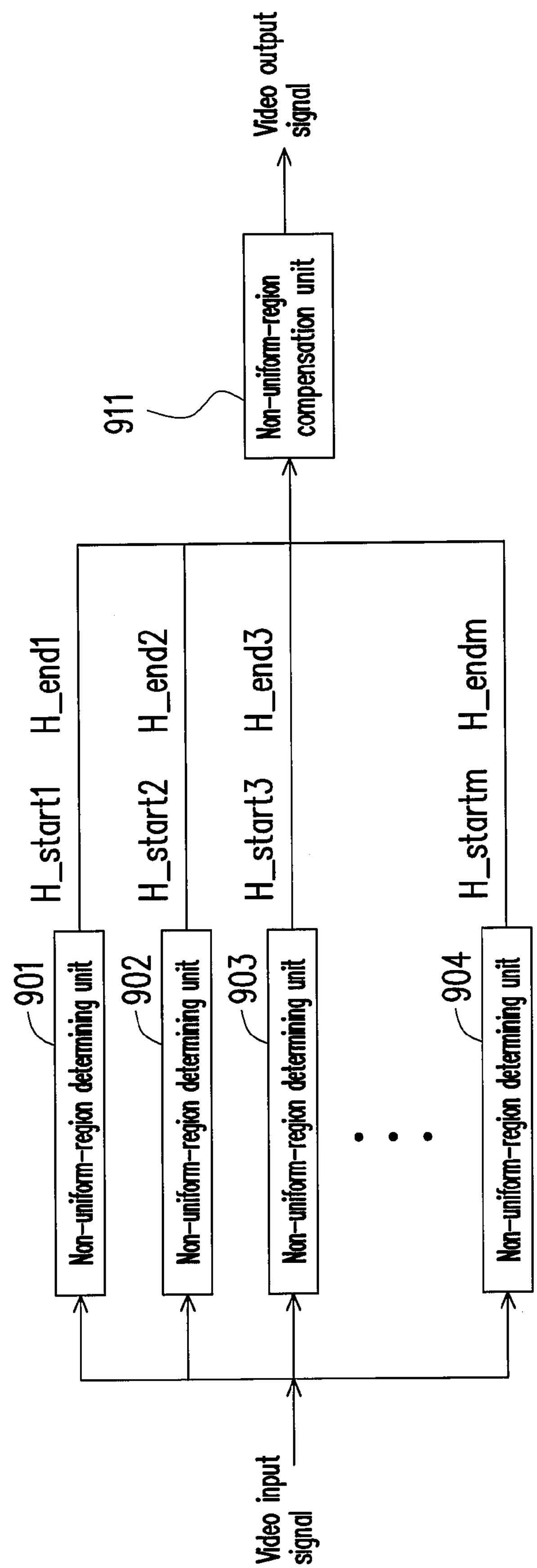

Video input signal
901
Non-uniform-region determining unit
902
Non-uniform-region determining unit
903
Non-uniform-region determining unit
904
Non-uniform-region determining unit
H_start1 H_end1
H_start2 H_end2
H_start3 H_end3
H_startm H_endm
911
Non-uniform-region compensation unit
Video output signal

FIG. 9A

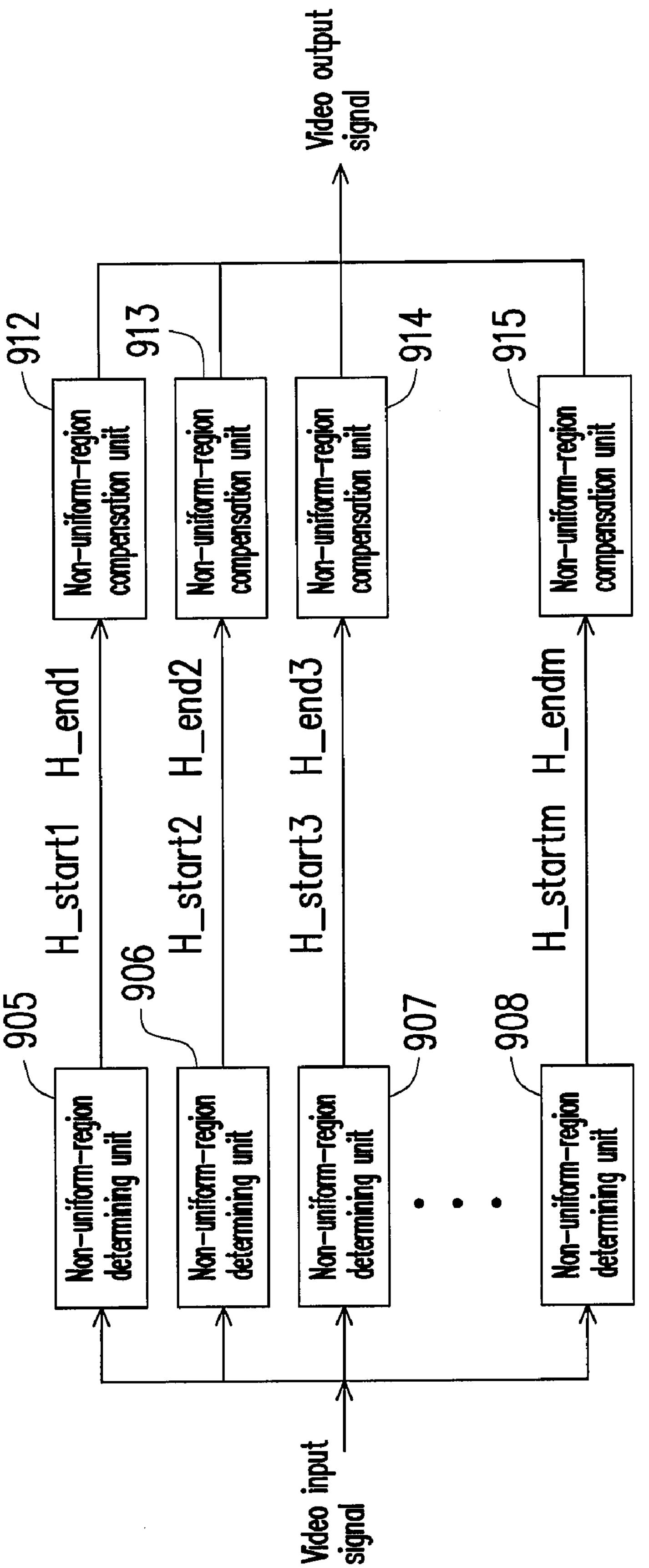

Video input signal
Non-uniform-region determining unit
905
Non-uniform-region determining unit
906
Non-uniform-region determining unit
907
Non-uniform-region determining unit
908
H_start1 H_end1
H_start2 H_end2
H_start3 H_end3
H_startm H_endm
Non-uniform-region compensation unit
912
Non-uniform-region compensation unit
913
Non-uniform-region compensation unit
914
Non-uniform-region compensation unit
915
Video output signal

FIG. 9B

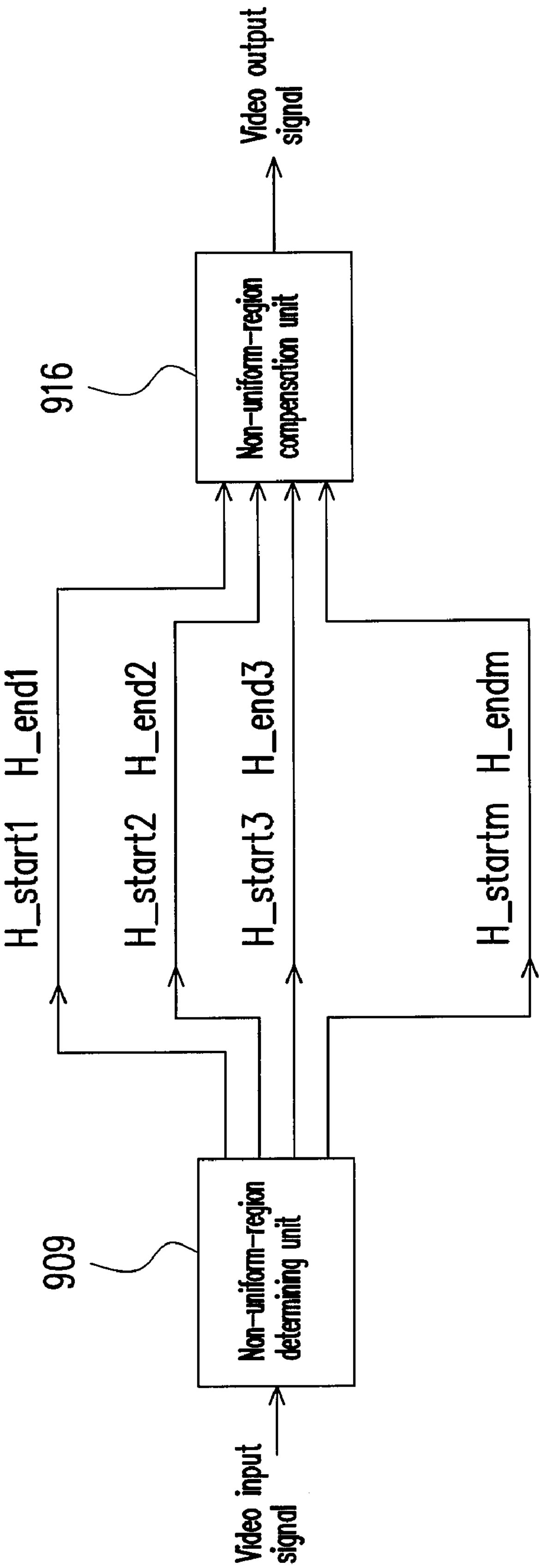

Video output signal
916
Non-uniform-region compensation unit
H_start1 H_end1
H_start2 H_end2
H_start3 H_end3
H_startm H_endm
909
Non-uniform-region determining unit
Video input signal

FIG. 9C

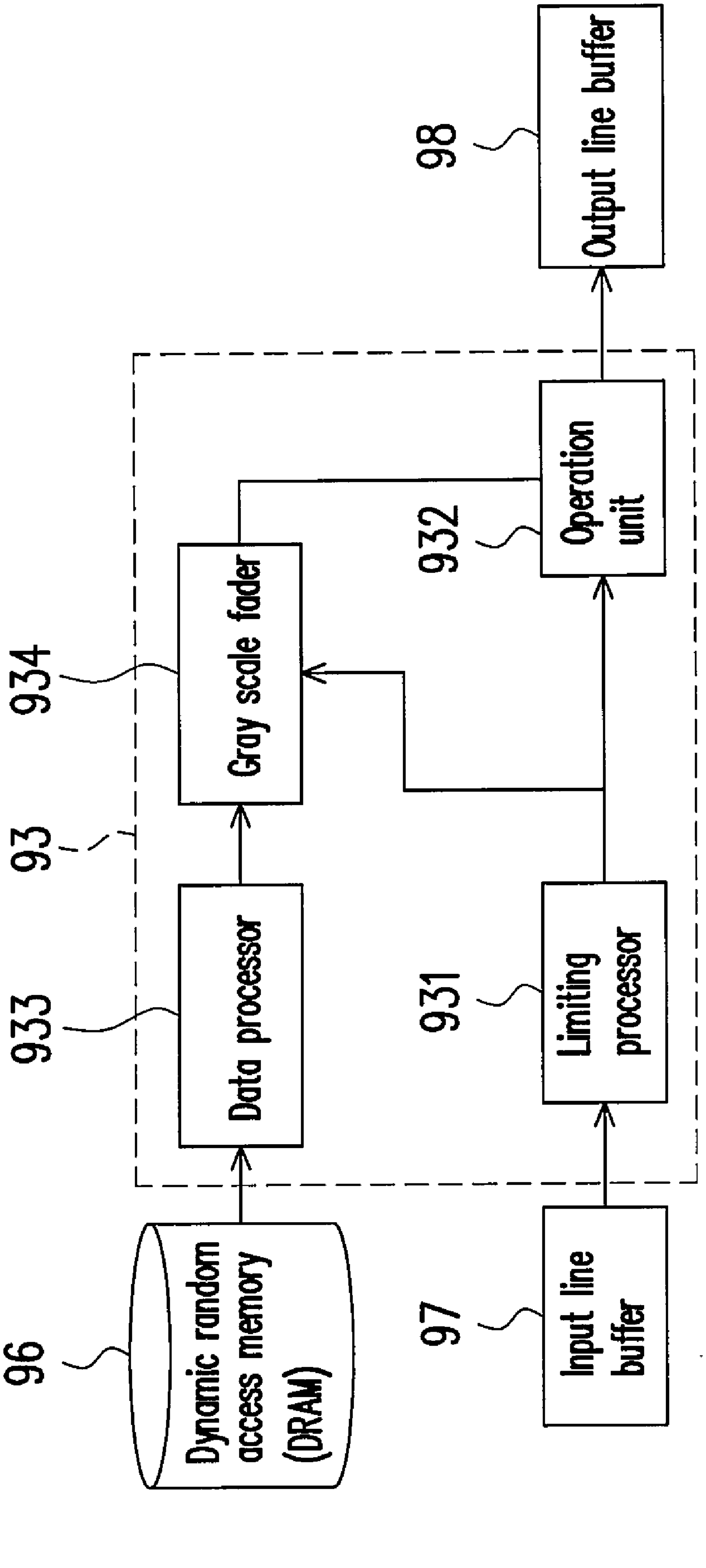

96
Dynamic random access memory (DRAM)
97
Input line buffer
933
Data processor
93
931
Limiting processor
934
Gray scale fader
932
Operation unit
98
Output line buffer

FIG. 9D

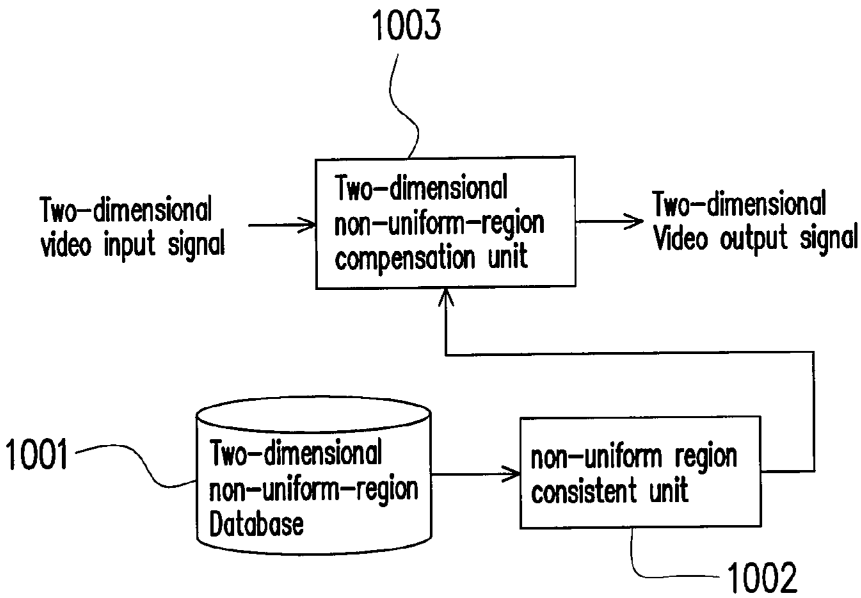


FIG. 10A

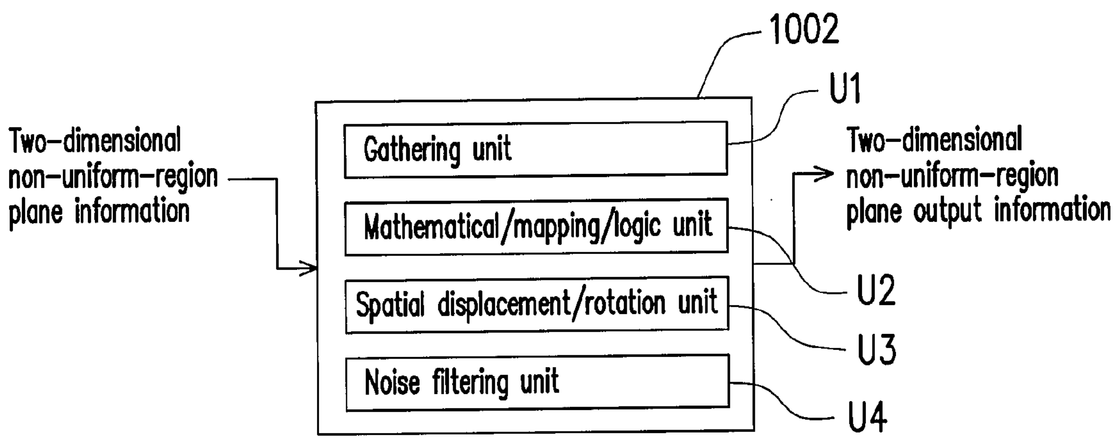


FIG. 10B

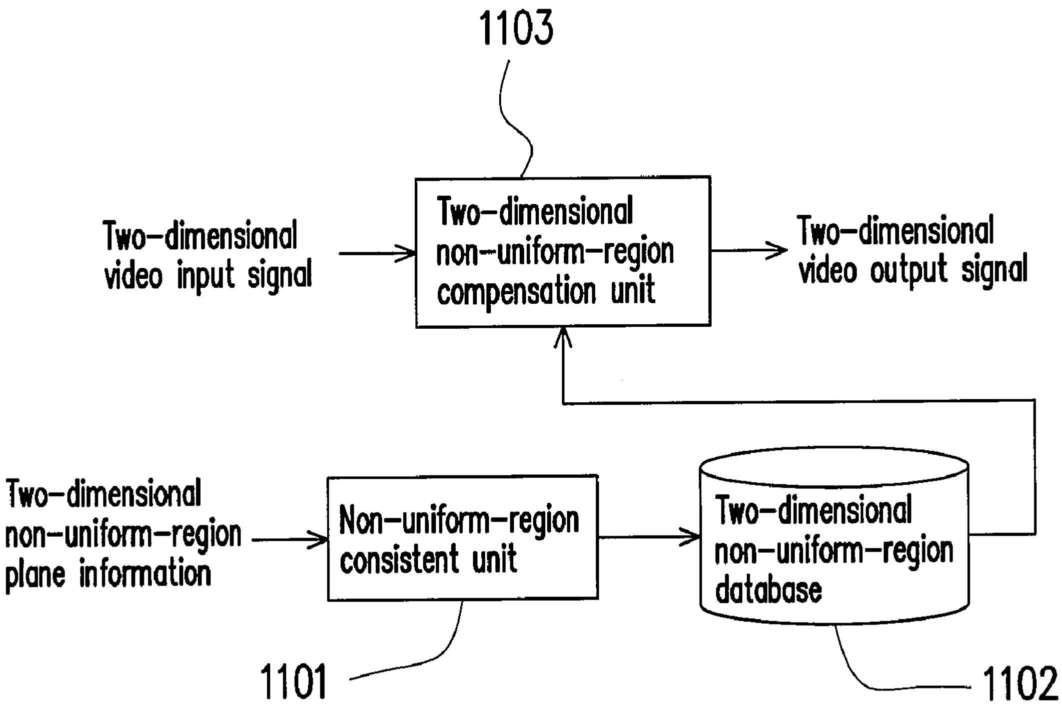

1103
Two-dimensional video input signal
Two-dimensional non-uniform-region compensation unit
Two-dimensional video output signal
Two-dimensional non-uniform-region plane information
Non-uniform-region consistent unit
Two-dimensional non-uniform-region database
1101
1102

FIG. 11

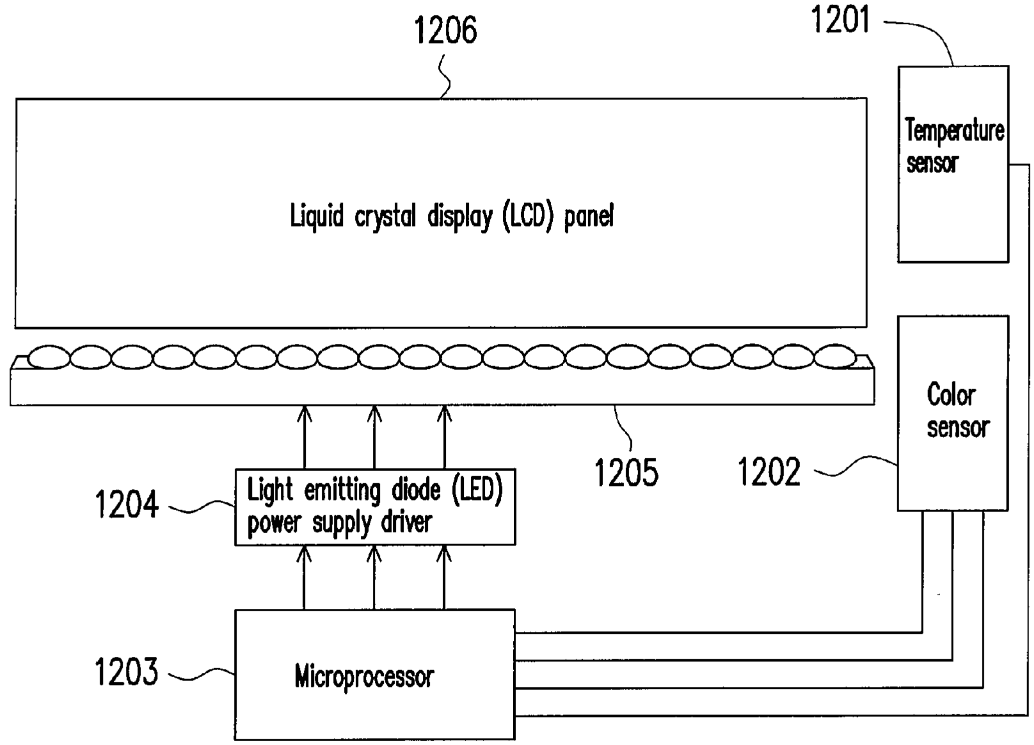


FIG. 12A

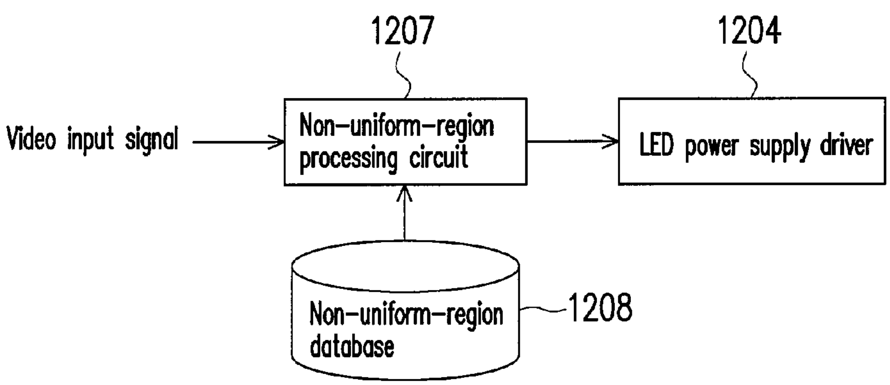


FIG. 12B

COMPENSATION HARDWARE DEVICE FOR NON-UNIFORM REGIONS IN FLAT PANEL DISPLAY

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority benefit of Taiwan applications serial no. **95131697**, filed Aug. 29, 2006, serial no. 94143840 filed Dec. 12, 2005 and serial no. 95131707 filed Aug. 29, 2006. All disclosures of the Taiwan applications are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of Invention

[0003] The present invention relates to a compensation hardware device for non-uniform regions used in a flat panel display. More particularly, the present invention relates to a compensation hardware device for non-uniform regions through digital processing.

[0004] 2. Description of Related Art

[0005] Various flat panel displays are developed directing to eliminate the disadvantages of conventional cathode ray tube (CRT) displays, such as heaviness and bulkiness. The flat panel displays can be classified into liquid crystal displays (LCDs), plasma displays, organic light emitting diode (OLED) displays and so on. Each of the above flat panel displays has its own advantages.

[0006] For an LCD, the process of the LCD panel relates to complicated flows and materials such as backlight module plates, polarizing films, brightness enhancement films, press fit of glass substrates. If a slight fault happens in one fabrication step, observable non-uniform regions will appear when a final light-on test is performed. The fault includes non-uniform colors and the so-called mura phenomenon. Moreover, observable non-uniform regions of various degrees may appear after the light-on test as the light provided by the backlight module plates is not uniform.

[0007] Therefore, the non-uniform regions are generally caused by problems in the backlight module plate of the display and poor fabrication processes of the liquid crystal panel. The characteristics of the non-uniform regions are usually distorted gray scales/colors with uncertain shapes. First, for the distorted gray scales/colors, the common non-uniform regions include, for example, white spots, dark spots, bright regions and dark regions, wherein the white spot and dark spot represent that some pixel has defects, and the bright region and dark region represent that the pixels in the region have defects. Next, the appearance of the non-uniform regions can be, for example, lateral stripes, 45° stripes, or straightly cut blocks appearing in one corner or scattering everywhere irregularly.

[0008] The non-uniform regions that greatly impact the visual effect generally attribute to the faults after the fabricating or assembling processes of the manufacturers. In order to reduce the non-uniform regions, the manufacturers usually improve the processes, for example, improving materials, thickness, etching, physical property/chemical property recipes, fabrication processes, etc., in de-mura and mura-free fields. Additionally, as an LCD panel is formed by a combination of two glass substrates, the faults occurred in the combination of the glass substrates may also lead to non-uniform regions. In another aspect, the faults in the designing, manufacturing and assembling of the backlight module plate of the LCD may also result in non-uniform regions.

[0009] Therefore, directing to the causes of non-uniform regions, the occurrence thereof can be reduced by improving the fabrication processes. Moreover, the causes of the non-uniform regions can be detected/classified by setting up several automatic monitoring stations during the fabrication processes for improvement. However, the aforementioned improving manner also has disadvantages. For example, the improvement of processes has to change the process parameters, such that the fabrication processes of a panel become more complicated. Additionally, the set-up of the monitoring stations results in a significant increase in the manufacturing cost of the panel. U.S. Patent Publication No. 20040179028 discloses a process compensation method, which increases the cost of the fabrication process in mass production. Moreover, U.S. Patent Publication No. 20050007364 discloses a process inspection method, which significantly increases the complexity of the fabrication process.

[0010] Accordingly, in the de-mura or mura-free fields, a technology for processing non-uniform regions in a panel through signal processing will be provided. Through the technology, the fabrication processes are not changed, and the non-uniform regions in the panels are processed appropriately.

SUMMARY OF THE INVENTION

[0011] The present invention is directed to providing a compensation hardware device for non-uniform regions through digital processing, which does not increase the manufacturing cost of the flat panel display as the non-uniform regions are not processed by means of materials, optical films or fabrication processes.

[0012] The present invention is further directed to providing a compensation hardware device for non-uniform regions through digital processing, so as to eliminate non-uniform regions in the panel by digital compensation.

[0013] The present invention is still directed to providing a compensation hardware device for non-uniform regions through digital processing, which is applicable to LCDs, plasma displays, OLED displays, rear-projection displays etc., and also applicable to LED backlight module plates to control direct compensation.

[0014] According to the above or other objectives, the present invention provides a compensation hardware device for non-uniform regions in a flat panel display, so as to eliminate the negative impact of the non-uniform regions in a panel on the display of a video signal. The compensation hardware device for non-uniform regions comprises a plurality of determining units for non-uniform regions and one or more compensation units for non-uniform regions. Each of the determining units for non-uniform regions determines whether the video signal falls in a normal region or a non-uniform region according to a location information for non-uniform regions. The compensation units for non-uniform regions appropriately compensate the video signals through digital processing according to a determination result from the corresponding determining units.

[0015] According to a compensation method for non-uniform regions disclosed in a preferred embodiment, the digital compensation can be performed by a mathematical operation unit, logic operation unit, direct mapping unit, dynamic operation unit or a combination thereof.

[0016] According to the above or other objectives, the present invention further provides a compensation hardware device for non-uniform regions in a flat panel display, so as to eliminate the negative impact of the non-uniform regions in a panel on the display of a video signal. The compensation hardware device comprises a non-uniform-region compensation unit for properly compensating the video signal through digital processing.

[0017] According to the above or other objectives, the present invention further provides a compensation hardware device for non-uniform regions in a flat panel display, so as to eliminate the negative impact of the non-uniform regions in a panel on the display of a two-dimensional video signal. The compensation hardware device comprises a database and at least a one-dimensional or two-dimensional non-uniform-region compensation unit. The database is used to store a plane information of non-uniform regions for determining whether the video signal falls in a normal region or a non-uniform region. The one-dimensional or two-dimensional non-uniform-region compensation unit properly compensates the video signal through digital processing according to the plane information of non-uniform regions.

[0018] The present invention compensates the video signal through digital processing, thus processing the non-uniform regions to improve the video quality instead of by materials, optical films or fabrication processes. Therefore, the manufacturing cost of the flat panel display will not be increased.

[0019] In order to make the aforementioned and other objectives, features and advantages of the present invention comprehensible, preferred embodiments accompanied with figures are described in detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. **1** is a functional block diagram according to an embodiment of the present invention.

[0021] FIG. **2** is a functional block diagram of the processing circuit **10** for non-uniform regions according to an embodiment of the present invention.

[0022] FIG. **3** is an operation chart of decompressing a video signal with a video decoder **31** according to an embodiment of the present invention.

[0023] FIG. **4** is a mapping relation graph of the algorithm.

[0024] FIG. **5**A is a region partition view of the non-uniform regions according to an embodiment of the present invention.

[0025] FIG. **5**B is a distribution view of the non-uniform regions according to an embodiment of the present invention.

[0026] FIG. **6**A is a curve diagram of dynamic operation according to an embodiment of the present invention.

[0027] FIG. **6**B is another curve diagram of dynamic operation according to the embodiment of the present invention.

[0028] FIG. **6**C is a curve diagram of dynamic operation according to another embodiment of the present invention.

[0029] FIG. **7** is a curve diagram of dynamic operation according to still another embodiment of the present invention.

[0030] FIG. **8** is a region distribution diagram of the flat panel display according to an embodiment of the present invention.

[0031] FIG. **9**A is a functional block diagram of the compensation hardware device for one-dimensional non-uniform regions according to an embodiment of the present invention.

[0032] FIG. **9**B is another functional block diagram of the compensation hardware device for one-dimensional non-uniform regions according to the embodiment of the present invention.

[0033] FIG. **9**C is still another functional block diagram of the compensation hardware device for one-dimensional non-uniform regions according to the embodiment of the present invention.

[0034] FIG. **9**D is a reference functional block diagram of a compensation hardware device for two-dimensional non-uniform regions according to an embodiment of the present invention.

[0035] FIG. **10**A is a functional block diagram of the compensation hardware device for two-dimensional non-uniform regions according to an embodiment of the present invention.

[0036] FIG. **10**B is a functional block diagram of the consistent unit **1002** for non-uniform regions in FIG. **10**A.

[0037] FIG. **11** is another functional block diagram of the compensation hardware device for two-dimensional non-uniform regions according to the embodiment of the present invention.

[0038] FIG. **12**A is a conventional functional block diagram of a display applying an OLED backlight module plate.

[0039] FIG. **12**B is a functional block diagram of the compensation hardware device for non-uniform regions according to the present invention applied to the OLED backlight module plate in FIG. **12**A.

DESCRIPTION OF EMBODIMENTS

[0040] The present invention resolves the problem of non-uniform regions in a panel through digital compensation. Seen from the following embodiments, video signals to be displayed in non-uniform regions are compensated by means of digital compensation such as mathematical operation, logic operation, direct mapping, dynamic operation or a combination thereof. Even though new types of non-uniform regions may appear in the future, these new non-uniform regions can still be processed by updating the aforementioned processes or by adding other digital compensation processes. In the de-mura or mura-free fields, the present invention provides digital compensation to process a defective panel, wherein the defective panel can be an LCD panel or an LED backlight module plate, so as to improve the quality and reduce the cost.

[0041] Referring to FIG. 1, it is a functional block diagram of processing the non-uniform regions according to an embodiment of the present invention. A database 15 for non-uniform regions is created in advance directing to the panel of an embodiment of the present invention. That is, after a light-on test is performed on the panel, the location information/type information/variation amount information and other associated information of the non-uniform regions in the panel are identified and then stored into the database 15 for non-uniform regions. It is known, the pixel is the minimum display unit for a panel. In the following description, the pixel falling in a non-uniform region is referred to as a non-uniform region pixel, and the pixel falling in a normal region is referred to as a normal-region pixel. Therefore, the location information of the database 15 includes the locations of all non-uniform region pixels. Additionally, as described above, the non-uniform regions at least can be classified into white spots, dark spots, bright regions, dark regions and so on. As the compensation method for each type of non-uniform regions is not identical, the type information should be acquired in addition to the location information when a non-uniform region is detected, so as to carry out the optimal compensation depending on the type of each of the non-uniform regions. Furthermore, the database 15 can record the correction/compensation manner of each type of the non-uniform regions, thereby facilitating the process of the processing circuit 10 for non-uniform regions.

[0042] After receiving the video input signal, the processing circuit 10 for non-uniform regions determines whether non-uniform region processing (compensation) should be performed on the video input signal and how to perform the non-uniform region processing according to the location information/type information/variation amount information of the non-uniform regions extracted from the database 15. Finally, the processed video signal or the video signal that does not need to be processed is output to a post-circuit (not shown). The video input signal at least includes the location information of the pixel, i.e., the location on which the video is displayed, and the information of gray scales/colors, i.e., the brightness/color of the video.

[0043] FIG. 2 is a functional block diagram of a non-uniform-region processing circuit according to an embodiment of the present invention. As shown in FIG. 2, the processing circuit 10 for non-uniform regions includes a determining unit 21 for non-uniform regions, a type switch unit 22 for non-uniform regions, a compensation unit 23 for non-uniform regions, a delay/bypass unit 24 and a path switch unit 25.

[0044] The determining unit 21 for non-uniform regions determines whether the received video input signal falls in a normal-region pixel or a non-uniform region pixel according to the location information of the non-uniform regions delivered from the database 15 for non-uniform regions. That is, the determining unit 21 for non-uniform regions compares the location information of the pixel of the video input signal with the location information of the non-uniform regions in the database 15. If the two pieces of information are consistent, the video input signal is determined to be falling in a non-uniform region pixel, otherwise in a normal-region pixel. Afterward, the determining unit 21 for non-uniform regions transmits the video input signal determined to be falling in a non-uniform region pixel and the type information M_type delivered from the database 15 to the type switch unit 22 for non-uniform regions.

[0045] According to the type information M_type, the type switch unit 22 for non-uniform regions transmits/switches the video input signal determined to be falling in a non-uniform region pixel to an appropriate operation unit within the compensation unit 23 for non-uniform regions.

[0046] The compensation unit 23 for non-uniform regions may include a mathematical operation unit 231, a logic operation unit 232, a direct mapping unit 233 and a dynamic operation unit 234. The mathematical operation unit 231 carries out a mathematical operation on (the gray scale/color information of) the video input signal delivered from the type switch unit 22 for non-uniform regions, such as addition/subtraction, multiplication/division and biased-offset. The logic operation unit 232 carries out a logic operation on (the gray scale/color information of) the video input information, such as logic "AND", logic "OR" and logic "XOR". The direct mapping unit 233 performs a mapping on (the gray scale/color information of) the video input signal, such as a look-up table (LUT) method. For example, when a bright region appears on the panel, the gray scale/color signal of the non-uniform region pixel can be adjusted and reduced via the LUT method, thereby achieving the effect of compensating the non-uniform regions. The dynamic operation unit 234 allocates different weighting values to the video input signals based on location or gray scale, so as to perform compensation. In the present invention, the digital compensation can be performed by the mathematical operation unit 231, the logic operation unit 232, the direct mapping unit 233, the dynamic operation unit 234 or a combination thereof. Moreover, in the compensation unit 23 for non-uniform regions, other digital operation units can be adopted on demands to process the non-uniform regions in different types of or new digital processing units, such that the embodiment of the present invention has extensibility.

[0047] Seen from an embodiment of the present invention, the present invention can reduce defective panels, process the non-uniform regions and provide an advanced digital compensation technique in the de-mura and mura-free fields.

[0048] Under a specific circumstance, a certain video input signal can be input to two or more units 231-234 simultaneously for performing a more appropriate compensation. The compensation unit 23 for non-uniform regions inputs the compensated video signal to the path switch unit 25. The path switch unit 25 is used to make sure that the sequence of the video signals output from the processing circuit 10 for non-uniform regions is correct. That is because, when a plurality of video input signals is continuously and sequentially input to the processing circuit 10 for non-uniform regions, the video signals after being processed also have to be output from the processing circuit 10 for non-uniform regions according to the original sequence for fear of generating a distorted video frame.

[0049] If the determining unit 21 for non-uniform regions determines that the video signal falls in a normal-region pixel, the video input signal (falling in the normal-region pixel) may be input to the delay/bypass unit 24. The delay/bypass unit 24 includes a register for registering the video signal falling in a normal-region pixel, if necessary. The reason why the video signal falling in the normal-region pixel should be registered is as follows. Provided that a certain (or some) video signal(s) is determined to be falling in a non-uniform region pixel, the non-uniform-region compensation unit takes some time to process the video signal, and meanwhile, a subsequent video signal is input to the processing circuit **10**.

[**0050**] If the subsequent video signal is determined to be falling in a normal-region pixel, the video signal will be registered (delayed) in the delay/bypass unit **24**, and cannot be output until the video signal originally falling in the non-uniform region pixel has been compensated, delivered to the path switch unit **25** and then been output. Under some circumstances, the video signal falling in the normal-region pixel can be passed to the path switch unit **25** without being registered/delayed.

[**0051**] The path switch unit **25** is controlled by a control signal CTL output by the determining unit **21** for non-uniform regions. The control signal CTL at least designates normal or mura for controlling the sequence of the continuously input video signals. According to the control signal CTL, the path switch unit **25** determines whether to output the corrected/compensated video signal output by the compensation unit **23** for non-uniform regions as a video output signal, or to output the uncompensated video signal by the delay/bypass unit **24**.

[**0052**] The following embodiments are used to explicitly illustrate the operating principle of the processing circuit **23** for non-uniform regions. Referring to FIG. **3**, it is an operation chart of decompressing a video signal with a video decoder **31** according to an embodiment of the present invention. Referring to FIGS. **3** and **2** together, the video signal is input into the video decoder **31**. The video decoder **31** decodes the video signal into a video input signal containing location information, and the determining unit **21** for non-uniform regions is used to determine whether a portion of the video input signal falls in a non-uniform region. As for the panel **32** in FIG. **3**, a non-uniform region NUR**1** is defined by the boundaries of H_start**1**, H_end**1**, V_start**1**, V_end**1**, and a non-uniform region NUR**2** is defined by the boundaries of H_start**2**, H_end**2**, V_start**2**, V_end**2**. If a portion of the video input signal is determined to be falling in the non-uniform region NUR**1** or NUR**2**, digital processing will be performed on the video signal.

[**0053**] An algorithm used by the determining unit **21** for non-uniform regions is as follows:

IF $x \epsilon$given[H_start1,H_end1]AND

$y \epsilon$givin[V_start1,V_end1],

THEN pixel_(x,y)$\epsilon NUR1$;

or IF(x,y)ϵgiven BitMAP/Contour/Boundary of $NUR1$,

THEN pixel_(x,y)$\epsilon NUR1$;

Similay for $NUR2$;

[**0054**] The first line of the algorithm represents that the horizontal coordinate x falls in a region defined by H_start**1** and H_end**1**, the second line represents that the longitudinal coordinate y falls in a region defined by V_start**1** and V_end**1**, and thus the third line determines that the video input signal falls in the non-uniform region NUR**1**. Or, by another determining mode, the video input signal is determined according to the bit map, contour, boundary of the non-uniform region NUR**1**. The BitMAP is a non-uniform region containing the boundaries and the interior. The contour is a non-uniform contour only containing the boundaries. After determining the type of a non-uniform block, the determining unit **21** for non-uniform regions performs subsequent compensation directing to the characteristics of the block. The last line represents that determination is also performed on the non-uniform region NUR**2** in the same way.

[**0055**] An algorithm used by the determining unit **21** for non-uniform regions is as follows:

IF pixel_(x,y)$\epsilon NUR1$,

THEN NUR_TYPE=TYPE1;

e.g., TYPE1 means white-spot,dark-spot . . .

similar for TYPE

[**0056**] The first line of the algorithm represents that if the pixel at the location (x, y) belongs to the non-uniform region NUR**1**, the parameter NUR_TYPE of the non-uniform region is set as TYPE**1** for recording types, such as white-spot and dark-spot, thus determining whether the video input signal falls in a non-uniform region of white spot or dark spot. Other TYPEs are similar.

[**0057**] Referring to FIG. **2**, the mathematical operation unit **231** is used to perform compensation, and an algorithm using mathematical operation to compensate is as follows:

$$
\begin{aligned}
[R\,G\,B] &= MATHFun([R\,G\,B],\,[dR\,dG\,dB]) \\
&= [R\,G\,B] + [dR\,dG\,dB];\text{ or} \\
&= [R\,G\,B] - [dR\,dG\,dB];\text{ or} \\
&= [R\,G\,B] + \text{gain}*[dR\,dG\,dB];\text{ or} \\
&= [R\,G\,B] - \text{gain}*[dR\,dG\,dB] + \text{offset};\ \ldots
\end{aligned}
$$

[**0058**] The first line of the algorithm sets the video output signal [RGB] as a mathematical formula (v\ideo input signal [RGB], compensation value [dR,dG,dB]), which performs the compensation mode from the second line to the fifth line based on each non-uniform region. The second to fifth lines represent adding various compensation values [dR,dG,dB] to the video output signal [RGB]. For example, the compensation value [dR,dG,dB] without gains is added to the video input signal [RGB] in the second line for performing compensation. The compensation value [dR,dG,dB] without gains is subtracted from the video input signal [RGB] in the third line to perform compensation. The fourth line adopts gains to adjust the compensation value [dR,dG,dB] and adds the video input signal [RGB]. Moreover, in the fifth line, besides adopting gains to adjust the compensation value [dR,dG,dB] and adding the video input signal [RGB], an offset value is further added. Those skilled in the art should understand that the compensation method of the mathematical operation unit **231** is not limited to the above algorithm, but can be adjusted by other mathematical operation formulas designed according to various non-uniform regions.

[**0059**] The logic operation unit **232** is used to perform compensation, and an algorithm using logic operation to compensate is as follows:

$$[R\ G\ B] = \text{Log}Fun([R\ G\ B], [dR\ dG\ dB])$$
$$= [R\ G\ B]\ \text{AND}\ [dR\ dG\ dB];\ \text{or}$$
$$= [R\ G\ B]\ \text{OR}\ [dR\ dG\ dB];\ \text{or}$$
$$= [R\ G\ B]\ XOR\ [dR\ dG\ dB];\ \ldots$$

[0060] The first line of the algorithm sets the video output signal [RGB] as a logic formula (video input signal [RGB], compensation value [dR,dG,dB]), which performs the compensation mode from the second line to the fourth line based on each non-uniform region. The second to fourth lines represent adding various compensation values [dR,dG,dB] to the video output signal [RGB]. For example, the video input signal [RGB] in the second line uses logic symbol "AND" to control the compensation value [dR,dG,dB] to perform compensation, the video input signal [RGB] in the third line uses logic symbol "OR" to control the compensation value [dR,dG,dB] to perform compensation, and the video input signal [RGB] in the fourth line uses logic symbol "XOR" to control the compensation value [dR,dG,dB] to perform compensation. Those skilled in the art should understand that the compensation method of the logic operation unit **232** is not limited to the above algorithm, but can be adjusted by other logic operation formulas designed according to various non-uniform regions.

[0061] The direct mapping unit **233** is used to perform compensation, and an algorithm using direct mapping operation to compensate is as follows:

$$[R\ G\ B] = MapFun([R\ G\ B], [dR\ dG\ dB])$$
$$= \text{cures decided by } LUT$$

[0062] Referring to FIG. **4**, it is a mapping relation view of the above algorithm. The horizontal axis represents the pixel brightness before mapping, and the longitudinal axis represents the pixel brightness after mapping. The first line of the algorithm sets the video output signal [RGB] as a mapping equation (video input signal [RGB], compensation value [dR,dG,dB]), and the compensation is performed respectively by mapping curves **401**, **402**, **403**. The mapping curves **401**, **402**, **403** are determined by an LUT, wherein dR maps R, dG maps G, dB maps B, or different color gamuts map one another, such as dR mapping G, dG mapping B, dB mapping R. Those skilled in the art should understand that the compensation method of the direct mapping unit **233** is not limited to the above mapping curves, but can be adjusted by other mapping curves designed according to various non-uniform regions.

[0063] Seen from the embodiments of the present invention, a defective panel in the present invention can be compensated by gains, offset, LUT, and logic operation, instead of by changing materials, optical films or fabrication processes and so on.

[0064] As for the dynamic operation unit **234**, the difference between the dynamic operation unit **234** and the aforementioned mathematical operation unit **231**, logic operation unit **232**, direct mapping unit **233** is that, the dynamic operation unit performs compensation gradually and uses location or gray scale brightness to adjust the weighting value for compensation. FIG. **5**A is a region partition view of the non-uniform regions according to an embodiment of the present invention. Straight lines LV**1**-LV**6** with different slopes mark out the non-uniform regions. FIG. **5**B is a distribution diagram of the non-uniform regions according to an embodiment of the present invention. Referring to FIGS. **5**A and **5**B together, in the frame **501**, an internal contour C**2** contains a region R**2**, and the internal contour C**2** and an external contour C**1** contain a region R**1**.

[0065] An algorithm adopting location dynamic operation to perform compensation is as follows:

$$[R'\ G'\ B'] = \text{SpaceFadingFun}([R\ G\ B], [dR\ dG\ dB], \text{SpaceWeighting}(\bullet))$$

e.g.,

$$[R'\ G'\ B']\_A = [R\ G\ B]\_A + [dR\ dG\ dB]\_A * \text{SpaceFadingWeighting}(R\_A);$$

e.g.,

$$[Y'\ U'\ V']\_A = [Y\ U\ V]\_A + [dY\ dU\ dV]\_A * \text{SpaceFadingWeighting}(R\_A);$$

[0066] Where R_A: distance of A point to NUR central point similarly, for YUV, YCbCr . . .

[0067] The first line of the algorithm sets the video output signal [R'G'B'] as a location dynamic operation equation (video input signal [RGB], compensation value [dR dG dB]*location fading weighting value (•)), which performs the dynamic operation of the algorithm according to the contour and boundary of the non-uniform region NUR. A video output signal [R'G'B']_A is set as a video input signal [RGB]_A plus the compensation values [dR dG dB]_A multiplied by the location fading weighting value (SpaceFadingWeighting(R_A)). Similarly, a video output signal [Y'U'V']_A is set as a video input signal [YUV]_A plus compensation values [dY dU dV]_A multiplied by the location fading weighting value (SpaceFadingWeighting(R_A)), wherein R_A represents the distance from the compensation point to the center of the non-uniform region. Referring to the algorithm, FIGS. **5**B and **6**A together, FIG. **6**A is a curve diagram of dynamic operation according to an embodiment of the present invention. The horizontal axis represents location, the longitudinal axis represents weighting value, and different weighting values of various pixels are adjusted by curves **601-604** according to locations between the internal contour C**1** and the external contour C**2**. For example, the center point S**1** has a weighting value of 1, and in such a progressive way, a more natural visual compensation effect can be achieved by the curves **601-604**. Those skilled in the art should understand that the compensation method of the dynamic operation unit **234** is not limited to the above dynamic operation curves, but can be adjusted by other location dynamic operation curves designed according to various non-uniform regions. FIG. **6**B is another curve diagram of dynamic operation according to the embodiment of the present invention. The horizontal axis represents location, the longitudinal axis represents weighting value, and different weighting values of various pixels are adjusted by curves **605-608** according to locations between the internal contour C**1** and the external contour C**2**. Referring to FIG. **6**C, it is a curve diagram of dynamic operation according to yet another embodiment of the present invention, wherein the horizontal axis represents location and the longitudinal axis represents weighting value. The difference between FIG. 6C and FIG. 6A is that, in FIG. 6C, six sections B1-B6 are disposed between the internal contour C1 and the external contour C2 for performing compensation, wherein the width of each section, i.e., the spatial delay/shift, is 2_n.

[0068] The weighting value of an embodiment of the present invention is gradually reduced from the center point to the periphery. Meanwhile, those skilled in the art should understand that the weighting value of the present invention is not limited to being gradually reduced from a normal region to a non-uniform region, but can be gradually increased from a normal region to a non-uniform region. In addition, the compensation can be performed from a single side or from double sides.

[0069] Another algorithm adopting gray scale dynamic operation to perform compensation is as follows:

[*R G B*]=GrayFadingFun([*R G B*][*dR dG dB*], GrayWeighting(•));

e.g.,

[*R' G' B'*]_*A*=[*R G B*]_*A*+[*dR dG dB*]_*A**GrayWeighting([*R G B*]_*A*);

e.g.,

[*Y' U' V'*]_*A*=[*Y U V*]_*A*+[*dY dU dV*]_*A**GrayWeighting([*Y U V*]_*A*);

[0070] Where GrayWeighting([R G B]):weighting depends on [R G B] grays; Similarly, for YUV,YCbCr.

[0071] The first line of the algorithm sets the video output signal [R'G'B'] as a gray scale dynamic operation equation (video input signal [RGB], compensation value [dR dG dB]*gray scale weighting value (•)), which performs the dynamic operation of the algorithm according to the gray scale value of the video input signal [RGB]. A video output signal [R'G'B']_A is set as a video input signal [RGB]_A plus the compensation value [dR dG dB]_A multiplied by the gray scale weighting value (GrayWeighting(R_A)). A video output signal [Y'U'V']_A is set as a video input signal [YUV]_A plus the compensation value [dY dU dV]_A multiplied by the gray scale weighting value (GrayWeighting(R_A)), wherein the gray scale weighting value (GrayWeighting(R_A)) of the RGB signal is determined by the gray scale distribution of the RGB, and it is the same with the signals YUV, YCbCr. Together referring to FIG. 7, it is a curve diagram of dynamic operation according to still another embodiment of the present invention, wherein the horizontal axis represents gray scale value of RGB and the longitudinal axis represents weighting value. In the algorithm, curves 701-704 are used to perform dynamic compensation, and different compensations are carried out at each side of the center point S2. Those skilled in the art should understand that the compensation method of the dynamic operation unit 234 is not limited to the above dynamic operation curves, but can be adjusted by other gray scale dynamic operation curves designed according to various non-uniform regions. Meanwhile, those skilled in the art should understand that the weighting value of the present invention is not limited to scale up according to the gray scale value, but can also scale down according to the gray scale value.

[0072] FIG. 8 is a region distribution diagram of the flat panel display according to an embodiment of the present invention. The flat panel display in FIG. 8 has non-uniform regions NUR1-NUR3, wherein the boundaries of the non-uniform region NUR1 are H_start1, H_end1, V_start1, V_end1, the boundaries of the non-uniform region NUR2 are H_start2, H_end2, V_start2, V_end2, and the boundaries of the non-uniform region NUR3 are H_start3, H_end3, V_start3, V_end3. A video line in FIG. 8 passes through the non-uniform regions NUR1-NUR3 respectively.

[0073] FIG. 9A is a functional block diagram of the compensation hardware device for one-dimensional non-uniform regions according to an embodiment of the present invention. The compensation hardware device for one-dimensional non-uniform regions includes determining units 901-904 for non-uniform regions and a compensation unit 911 for non-uniform regions. Referring to FIGS. 8 and 9A together, the video input signal on the video line in FIG. 8 is input to the determining units 901-904 for non-uniform regions. The determining units 901-904 for non-uniform regions have a structure identical to that of the determining unit 21 for non-uniform regions in FIG. 2. The determining unit 901 for non-uniform regions determines the non-uniform region NUR1 via the boundaries H_start1 and H_end1 passing through the video line. The determining unit 902 for non-uniform regions determines the non-uniform region NUR2 via the boundaries H_start2 and H_end2 passing through the video line. The determining unit 903 for non-uniform regions determines the non-uniform region NUR3 via the boundaries H_start3 and H_end3 passing through the video line. The compensation hardware device for one-dimensional non-uniform regions is not limited to only determine three non-uniform regions, but can have, for example, a determining unit 904 for non-uniform regions to determine a region defined by the boundaries H_startm, H_endm, ensure the portion of the video input signal entering the non-uniform regions NUR1-NUR3 and being compensated through the compensation unit 911 for non-uniform regions, so as to generate a video output signal.

[0074] The compensation unit 911 for non-uniform regions has a structure identical to that of the compensation unit 23 for non-uniform regions in FIG. 2. A mathematical operation unit can be employed to perform mathematical operation on the gray scale/color information of the video input signal, such as addition/subtraction, multiplication/division and biased-offset. Or, a logic operation unit can be employed to perform logic operation on the gray scale/color information of the video input signal, such as logic “AND”, logic “OR” and logic “XOR”. Or, a direct mapping unit can be employed to perform direct mapping on the gray scale/color information of the video input signal, such as LUT method. Or, a dynamic operation unit can be employed to perform compensation on the video input signal by allocating different weighting values according to location or gray scale. The compensation unit 911 for non-uniform regions adopts the mathematical operation unit, logic operation unit, direct mapping unit, dynamic operation unit or a combination thereof to perform digital compensation. Moreover, other digital operation units can be adopted on demands to process the non-uniform regions in different types of or new digital processing units, such that the embodiment of the present invention has extensibility.

[0075] FIG. 9B is another functional block diagram of the compensation hardware device for one-dimensional non-uniform regions according to the embodiment of the present invention. The compensation hardware device for one-dimensional non-uniform regions includes determining units **905-908** for non-uniform regions and compensation units **912-915** for non-uniform regions. The major difference between the embodiment in FIG. **9**B and the embodiment in FIG. **9**A lies in the quantity of the determining unit corresponding to the compensation unit. In FIG. **9**B, the determining units **905-908** for non-uniform regions respectively correspond to the compensation units **912-915** for non-uniform regions. The determining unit **905** determines the portion of the video input signal falling in the non-uniform region NUR**1**, and the compensation unit **912** performs a first type of compensation, for example, logic operation. The determining unit **906** determines the portion of the video input signal falling in the non-uniform region NUR**2**, and the compensation unit **913** performs a second type of compensation, for example, mathematical operation. The determining unit **907** determines the portion of the video input signal falling in the non-uniform region NUR**3**, and the compensation unit **914** performs a third type of compensation, for example, direct mapping operation. After the determination of the determining unit **908**, the compensation unit **915** performs a fourth compensation, for example, dynamic compensation. The compensation units **911-915** for non-uniform regions respectively adopt the mathematical operation unit, logic operation unit, direct mapping unit, dynamic operation unit or a combination thereof to perform digital compensation. Moreover, other digital operation units can be adopted on demands to process the non-uniform regions in different types of or new digital processing units, such that the embodiment of the present invention has extensibility.

[0076] FIG. **9**C is still another functional block diagram of the compensation hardware device for one-dimensional non-uniform regions according to the embodiment of the present invention. The compensation hardware device for one-dimensional non-uniform regions includes a determining unit **909** for non-uniform regions and a compensation unit **916** for non-uniform regions. The determining unit **909** for non-uniform regions uses a plurality of linear inequations to determine the portion of the video input signal falling in the non-uniform regions NUR**1**-NUR**3**. The determining method for linear inequations can refer to FIG. **5**A, wherein a plurality of straight lines, for example, LV**1**-LV**6** is adopted to enclose the required region, and then the compensation unit **916** is used to perform digital compensation. The compensation unit **916** for non-uniform regions adopts the mathematical operation unit, logic operation unit, direct mapping unit, dynamic operation unit or a combination thereof to perform digital compensation. Moreover, other digital operation units can be adopted on demands to process the non-uniform regions in different types of or new digital processing units, such that the embodiment of the present invention has extensibility. In FIGS. **9**A-**9**C, the compensation hardware device for non-uniform regions can be disposed on a chip to save area.

[0077] FIG. **9**D is a reference functional block diagram of a compensation hardware device for two-dimensional non-uniform regions according to an embodiment of the present invention. The compensation hardware device for two-dimensional non-uniform regions includes a processing circuit **93** for non-uniform regions, a dynamic random access memory (DRAM) **96**, an input line buffer **97** and an output line buffer **98**. The data of the input line buffer **97** is input into the processing circuit **93** for non-uniform regions and then into the output line buffer **98**. The processing circuit **93** for non-uniform regions includes a limiting processor **931**, an operation unit **932**, a data processor **933** and a gray scale fader **934**, wherein the limiting processor **931** is used to limit the magnitude of the video signal. The data of non-uniform regions and the information of variation amount are stored beforehand in the DRAM **96**, and the operation unit **932** can perform, for example, logic operation and mathematical operation. The data processor **933** receives the data from the DRAM **96** to perform decoding/decompressing, and then inputs the data to the gray scale fader **934**. After that, according to the magnitude of the video signal, the gray scale fader **934** performs gray scale fading of different weighting values on the variation amount information of non-uniform regions stored in the DRAM **96**. Afterward, the video signal is input to the operation unit **932**. Compared with the compensation hardware device for one-dimensional non-uniform regions, the compensation hardware device for two-dimensional non-uniform regions is characterized in having low complexity but high cost.

[0078] FIG. **10**A is a functional block diagram of the compensation hardware device for two-dimensional non-uniform regions according to an embodiment of the present invention. The compensation hardware device for two-dimensional non-uniform regions includes a database **1001** for two-dimensional non-uniform regions, a consistent unit **1002** for two-dimensional non-uniform regions and a compensation unit **1003** for two-dimensional non-uniform regions. The database **1001** records the distribution information of non-uniform regions for a flat panel display. The distribution information is first processed by the consistent unit **1002** and then input into the compensation unit **1003**, such that the compensation unit **1003** performs digital compensation on the video input signal, thus generating a two-dimensional video output signal. Comparing with FIG. **9**D, the database **1001** can be the DRAM **96** in FIG. **9**D, the consistent unit **1002** can be considered as a general functionality description of the data processor **933** in FIG. **9**D, and the compensation unit **1003** can be the processing circuit **93** in FIG. **9**D.

[0079] FIG. **10**B is a functional block diagram of the consistent unit **1002** for non-uniform regions in FIG. **10**A. The consistent unit **1002** for non-uniform regions includes a gathering unit U**1**, a mathematical/mapping/logic unit U**2**, a spatial displacement/rotation unit U**3** and a noise filtering unit U**4**. The gathering unit U**1** is used to gather a plurality of small non-uniform regions into a large distribution region. The mathematical/mapping/logic unit U**2** is used to process the distribution information in advance through mathematical operation, direct mapping or logic operation, for example, addition/subtraction/multiplication/division, slicing, LUT, logic "AND", logic "OR" and logic "XOR". The spatial displacement/rotation unit U**3** is used to enable the non-uniform regions recorded in the distribution information to move upward/downward/leftward/rightward or rotate in the space. The noise filtering unit U**4** is used to filter the noises in the distribution information, for example, by using a low-pass filter, a high-pass filter, masking, unsharpness, sharpness and histogram. The consistent unit **1002** for non-uniform regions uses the gathering unit U**1**, mathematical/mapping/logic unit U**2**, spatial displacement/rotation unit U**3**, noise filtering unit U**4** or a combination thereof to perform video processing. Moreover, other consistent units can be adopted on demands to perform different types of or new video processing on the non-uniform regions, such that the embodiment of the present invention has extensibility.

[0080] FIG. **11** is another functional block diagram of the compensation hardware device for two-dimensional non-uniform regions according to the embodiment of the present invention. The compensation hardware device for two-dimensional non-uniform regions includes a consistent unit **1101** for non-uniform regions, a database **1102** for two-dimensional non-uniform regions and a compensation unit **1103** for two-dimensional non-uniform regions. The major difference between FIG. **11** and FIG. **10**A is that, the consistent unit **1101** for non-uniform regions is disposed in front of the database **1102** for two-dimensional non-uniform regions, and the two-dimensional non-uniform-region plane information is transmitted to the database **1102** for two-dimensional non-uniform regions after being processed by the consistent unit **1101** for non-uniform regions. The consistent unit **1101** for non-uniform regions can perform video processing via a computer on the two-dimensional non-uniform-region plane information. After that, the plane information is transmitted to the database **1102** to be stored therein. The database **1102** then controls the compensation unit **1103** for two-dimensional non-uniform regions to receive the Two-dimensional video input signal. The compensation unit **1103** for two-dimensional non-uniform regions generates a two-dimensional video output signal after compensating the two-dimensional video input signal. The consistent unit **1101** for non-uniform regions that performs via a computer can implement functions as the gathering unit, mathematical/mapping/logic unit, spatial displacement/rotation unit and noise filtering unit. Moreover, computer programs can be adopted on demands to perform different types of or new video processing on the two-dimensional non-uniform plane information, such that the embodiment of the present invention has extensibility. In FIG. **10**A or **11**, the compensation hardware device for non-uniform regions can be disposed on a chip to save area.

[0081] FIG. **12**A is a functional block diagram of a display applying an LED backlight module plate according to an embodiment of the present invention. The display includes a temperature sensor **1201**, a color sensor **1202**, a Microprocessor **1203**, an LED power supply driver **1204**, an LED backlight module plate **1205** and an LCD panel **1206**. The color sensor **1202** inputs the video signal into the Microprocessor **1203**, and the Microprocessor **1203** receives the signal from the temperature sensor **1201** to drive the LED power supple driver **1204**. The Microprocessor **1203** may include a compensation hardware device for non-uniform regions. The Microprocessor **1203** and the hardware device for non-uniform regions can be implemented on one chip or different chips, wherein the data of non-uniform regions for the LED backlight module plate **1205** is stored in advance, and then the video signal is compensated and input to the LED power supply driver **1204**, such that the LED power supply driver **1204** drives the LED backlight module plate **1205**. Those skilled in the art should understand that, the compensation hardware device for non-uniform regions is not limited to be disposed in the Microprocessor **1203**, but can be disposed in the path of the video signal to compensate the video signal in advance, such that the LED backlight module plate **1205** may emit a light of adjusted brightness or color, thus improving the display quality of the LCD panel **1206**.

[0082] FIG. **12**B is a functional block diagram of the compensation hardware device for non-uniform regions according to the present invention applied to the LED backlight module plate in FIG. **12**A. The processing unit **1207** for non-uniform regions and the database **1208** for non-uniform regions constitute a compensation hardware device for non-uniform regions, for example, on one chip or different chips. The video input signal is input to the processing unit **1207** for non-uniform regions, and then input to the LED power supply driver **1204** to compensate the data of non-uniform regions for the LED backlight module plate **1205**. In the above embodiment of the present invention, the non-uniform regions of the LED backlight module plate are not processed by materials, optical films or fabrication processes, so the manufacturing cost and complexity of the LED backlight module plate will not be increased.

[0083] In view of the above, the present invention compensates the video signal through digital processing, so as to process the non-uniform regions to improve the video quality instead of by materials, optical films or fabrication processes. Therefore, the manufacturing cost of the flat panel display will not be increased.

[0084] Though the present invention has been disclosed above by the preferred embodiments, they are not intended to limit the present invention. Anybody skilled in the art can make some modifications and variations without departing from the spirit and scope of the present invention. Therefore, the protecting range of the present invention falls in the appended claims.

What is claimed is:

1. A compensation hardware device for non-uniform regions, used in a flat panel display for eliminating non-uniform regions in a panel, the compensation hardware device comprising:

at least one non-uniform-region determining unit, for receiving a video signal, and respectively determining whether the video signal falls in a non-uniform-region pixel or a normal-region pixel according to a location information of non-uniform regions; and

at least one non-uniform-region compensation unit, for compensating the video signal through digital processing according to a determination result from the determining units for non-uniform regions.

2. The compensation hardware device for non-uniform regions as claimed in claim 1, further comprising a database for storing the location information of non-uniform regions.

3. The compensation hardware device for non-uniform regions as claimed in claim 1, wherein the non-uniform-region compensation unit comprises a mathematical operation unit through which the non-uniform-region compensation unit performs compensation on the video signal.

4. The compensation hardware device for non-uniform regions as claimed in claim 1, wherein the non-uniform-region compensation unit comprises a logic operation unit through which the non-uniform-region compensation unit performs compensation on the video signal.

5. The compensation hardware device for non-uniform regions as claimed in claim 1, wherein the non-uniform-region compensation unit comprises a direct mapping unit through which the non-uniform-region compensation unit performs compensation on the video signal.

6. The compensation hardware device for non-uniform regions as claimed in claim 1, wherein the non-uniform-region compensation unit comprises a dynamic operation unit for performing compensation on the video signal according to the weighting value of each pixel of the panel.

7. The compensation hardware device for non-uniform regions as claimed in claim 6, wherein the weighting value of each pixel of the panel is a location function.

8. The compensation hardware device for non-uniform regions as claimed in claim 6, wherein the weighting value of each pixel of the panel is a gray scale function.

9. The compensation hardware device for non-uniform regions as claimed in claim 1, wherein the compensation hardware device for non-uniform regions compensates the video signal through digital processing, and inputs the compensated video signal to a light emitting diode (LED) power supply driver to control an LED backlight module plate.

10. The compensation hardware device for non-uniform regions as claimed in claim 1, wherein the compensation hardware device for non-uniform regions is a chip.

11. The compensation hardware device for non-uniform regions as claimed in claim 1, wherein the panel is an LCD panel.

12. The compensation hardware device for non-uniform regions as claimed in claim 1, wherein the panel is an LED backlight module plate.

13. A compensation hardware device for non-uniform regions, used in a flat panel display for eliminating the negative impact of non-uniform regions in a panel on the display of a two-dimensional video signal, the compensation hardware device comprising:

a database, for storing a plane information of non-uniform regions, comprising location information; and

at least one two-dimensional non-uniform-region compensation unit, for performing proper compensation on the two-dimensional video signal through digital processing according to the plane information of non-uniform regions.

14. The compensation hardware device for non-uniform regions as claimed in claim 13, wherein the database further comprises a variation amount information of the panel.

15. The compensation hardware device for non-uniform regions as claimed in claim 14, further comprising a non-uniform region consistent unit, wherein the non-uniform region consistent unit is used to process the plane information of non-uniform regions, so as to make the plane information of non-uniform regions consistent with the optical measurement result of the video signal of non-uniform regions on the surface of the panel.

16. The compensation hardware device for non-uniform regions as claimed in claim 15, wherein the non-uniform region consistent unit comprises a gathering unit for gathering a plurality of small non-uniform regions of the plane information of non-uniform regions into a large non-uniform region.

17. The compensation hardware device for non-uniform regions as claimed in claim 15, wherein the non-uniform region consistent unit comprises a mathematical unit for performing mathematical operation on the plane information of non-uniform regions.

18. The compensation hardware device for non-uniform regions as claimed in claim 15, wherein the non-uniform region consistent unit comprises a mapping unit for performing mapping operation on the plane information of non-uniform regions.

19. The compensation hardware device for non-uniform regions as claimed in claim 15, wherein the non-uniform region consistent unit comprises a logic unit for performing logic operation on the plane information of non-uniform regions.

20. The compensation hardware device for non-uniform regions as claimed in claim 15, wherein the non-uniform region consistent unit comprises a spatial displacement unit for performing spatial displacement operation on the plane information of non-uniform regions.

21. The compensation hardware device for non-uniform regions as claimed in claim 15, wherein the non-uniform region consistent unit comprises a noise filtering unit for filtering the noises in the plane information of non-uniform regions.

22. The compensation hardware device for non-uniform regions as claimed in claim 13, wherein the non-uniform-region compensation unit comprises a mathematical operation unit through which the non-uniform-region compensation unit performs compensation on the two-dimensional video signal.

23. The compensation hardware device for non-uniform regions as claimed in claim 13, wherein the non-uniform-region compensation unit comprises a logic operation unit through which the non-uniform-region compensation unit performs compensation on the two-dimensional video signal.

24. The compensation hardware device for non-uniform regions as claimed in claim 13, wherein the non-uniform-region compensation unit comprises a direct mapping unit through which the non-uniform-region compensation unit performs compensation on the two-dimensional video signal.

25. The compensation hardware device for non-uniform regions as claimed in claim 13, wherein the non-uniform-region compensation unit comprises a dynamic operation unit used for performing compensation on the two-dimensional video signal according to the weighting value of each pixel of the panel.

26. The compensation hardware device for non-uniform regions as claimed in claim 25, wherein the weighting value of each pixel of the panel is a location function.

27. The compensation hardware device for non-uniform regions as claimed in claim 25, wherein the weighting value of each pixel of the panel is a gray scale function.

28. The compensation hardware device for non-uniform regions as claimed in claim 13, wherein the compensation hardware device for non-uniform regions compensates the two-dimensional video signal through digital processing, and inputs the compensated two-dimensional video signal to an LED power supply driver to control an LED backlight module plate.

29. The compensation hardware device for non-uniform regions as claimed in claim 13, wherein the compensation hardware device for non-uniform regions is a chip.

30. The compensation hardware device for non-uniform regions as claimed in claim 13, wherein the panel is an LCD panel or an LED backlight module plate.

31. The compensation hardware device for non-uniform regions as claimed in claim 13, wherein the panel is an LED backlight module plate.

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