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Chen(10) **Pub. No.: US 2019/0311686 A1**(43) **Pub. Date: Oct. 10, 2019**(54) **LIQUID CRYSTAL DISPLAY AND METHOD
FOR DRIVING SAME****Publication Classification**(51) **Int. Cl.****G09G 3/34** (2006.01)**G09G 3/36** (2006.01)(52) **U.S. Cl.**CPC ... **G09G 3/3426** (2013.01); **G09G 2310/0254**(2013.01); **G09G 2320/062** (2013.01); **G09G****3/3677** (2013.01)(71) Applicants: **HKC Corporation Limited,**
Guangdong (CN); **Chongqing HKC**
Optoelectronics Technology Co., Ltd.,
Chongqing (CN)(72) Inventor: **Yu-Jen Chen,** Chongqing (CN)(73) Assignees: **HKC Corporation Limited,**
Guangdong (CN); **Chongqing HKC**
Optoelectronics Technology Co., Ltd.,
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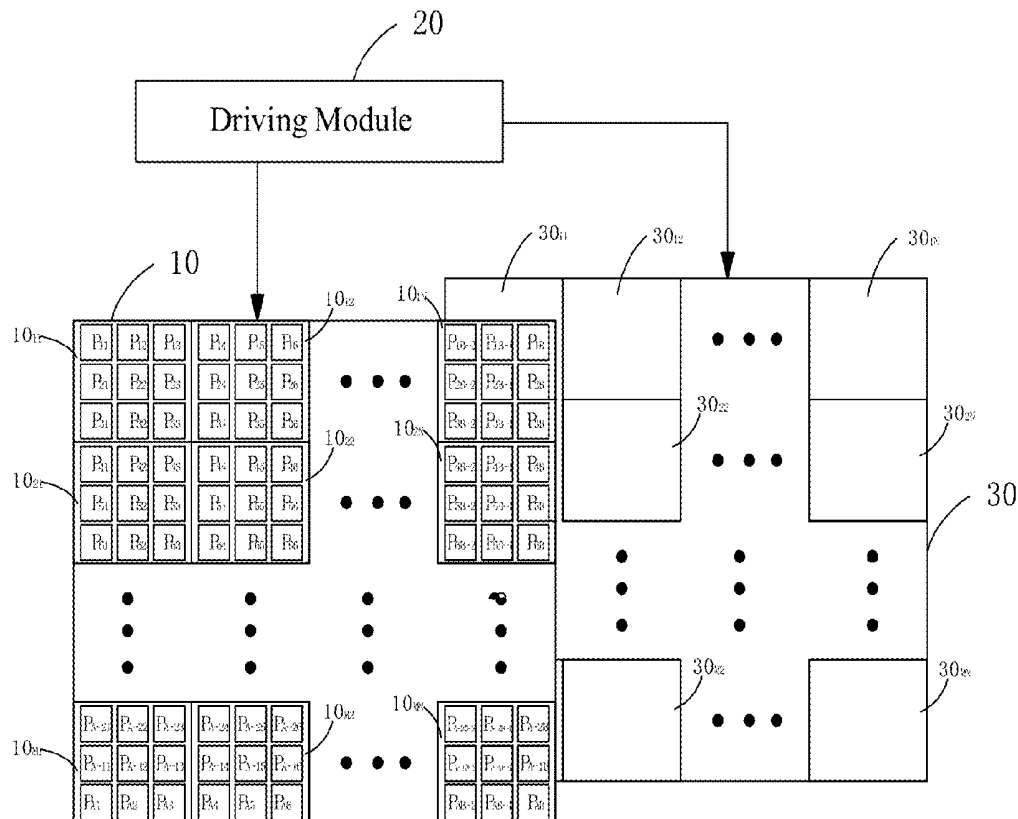
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(57)

ABSTRACT

Disclosed is a liquid crystal display, comprising a liquid crystal panel 10 and a driving module 20. The liquid crystal panel 10 comprises a plurality of liquid crystal pixels P_{ab} arranged in an array. The liquid crystal display is configured to display the same picture in two frames separated by one frame. The driving module 20 is used for separately providing different pixel voltages of the same polarity to each liquid crystal pixel in the two frames separated by one frame, so as to deflect liquid crystal molecules of each liquid crystal pixel. In each of the two frames separated by one frame, the pixel voltage of each liquid crystal pixel is different from the pixel voltages of adjacent liquid crystal pixels around. Also disclosed is a method for driving a liquid crystal display.



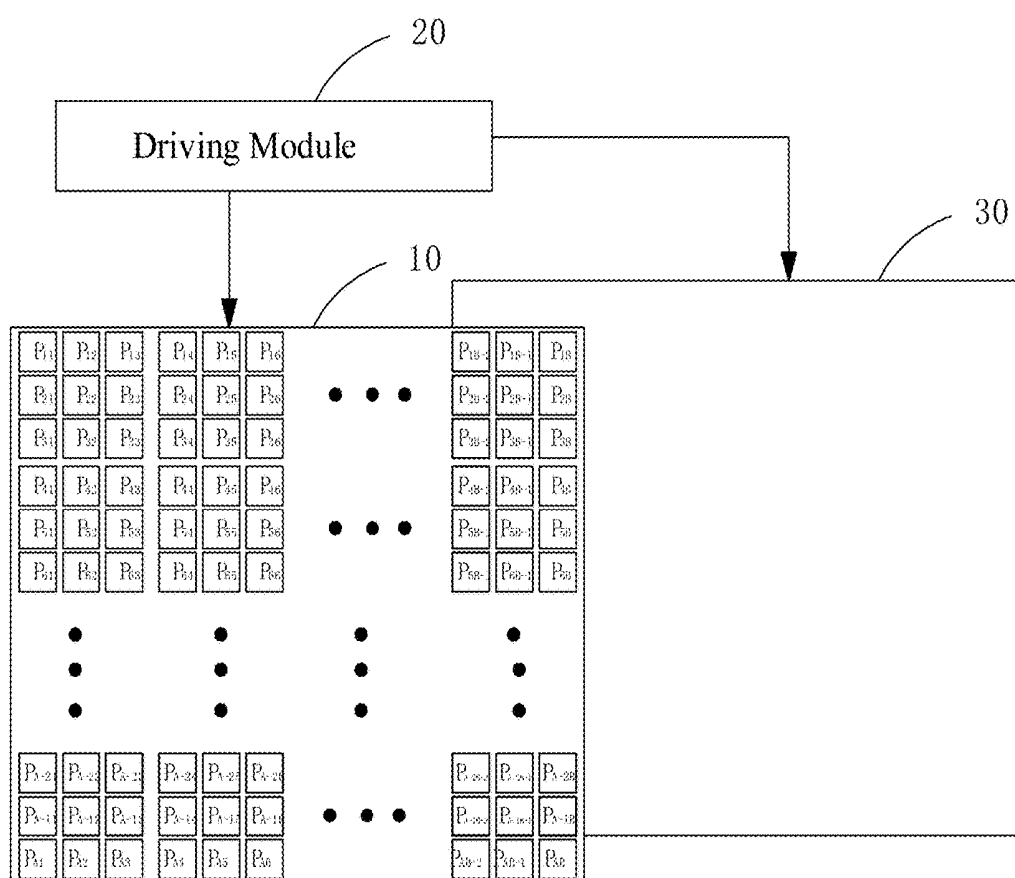


FIG. 1

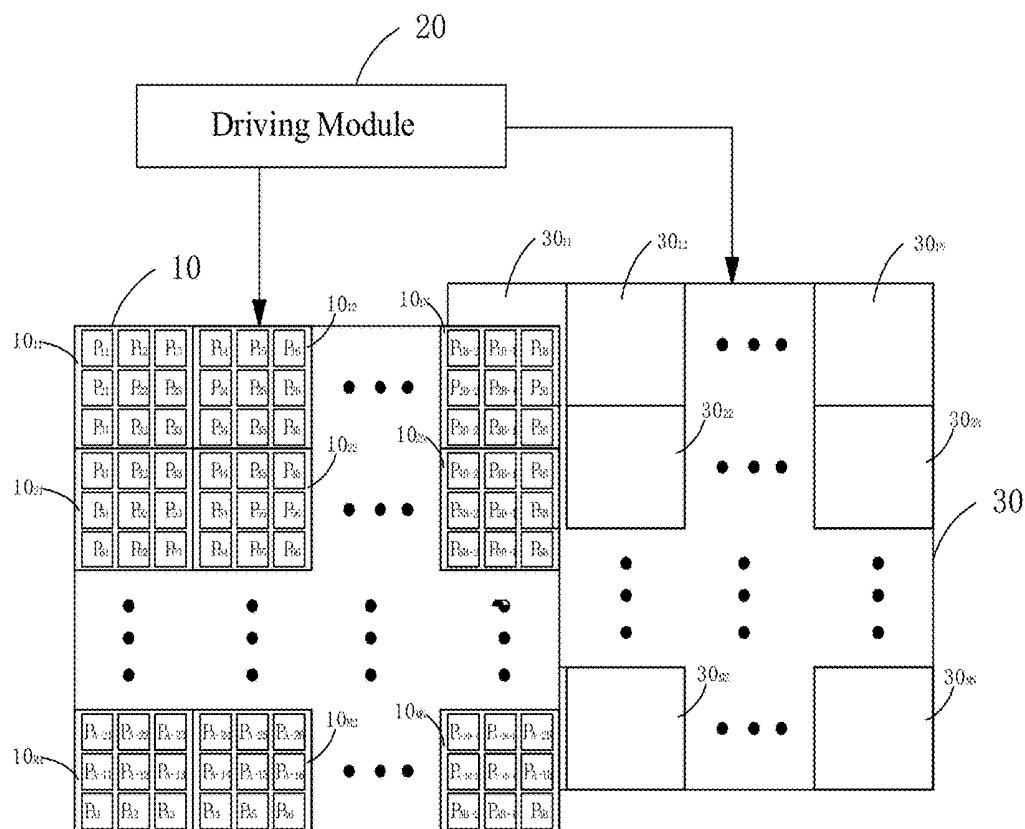


FIG. 2

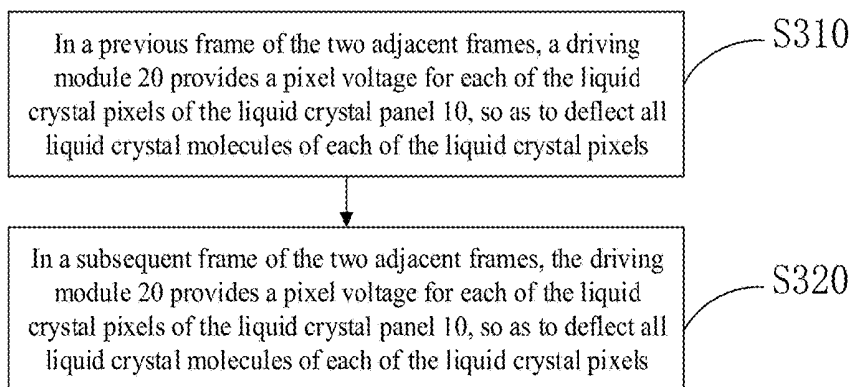


FIG. 3

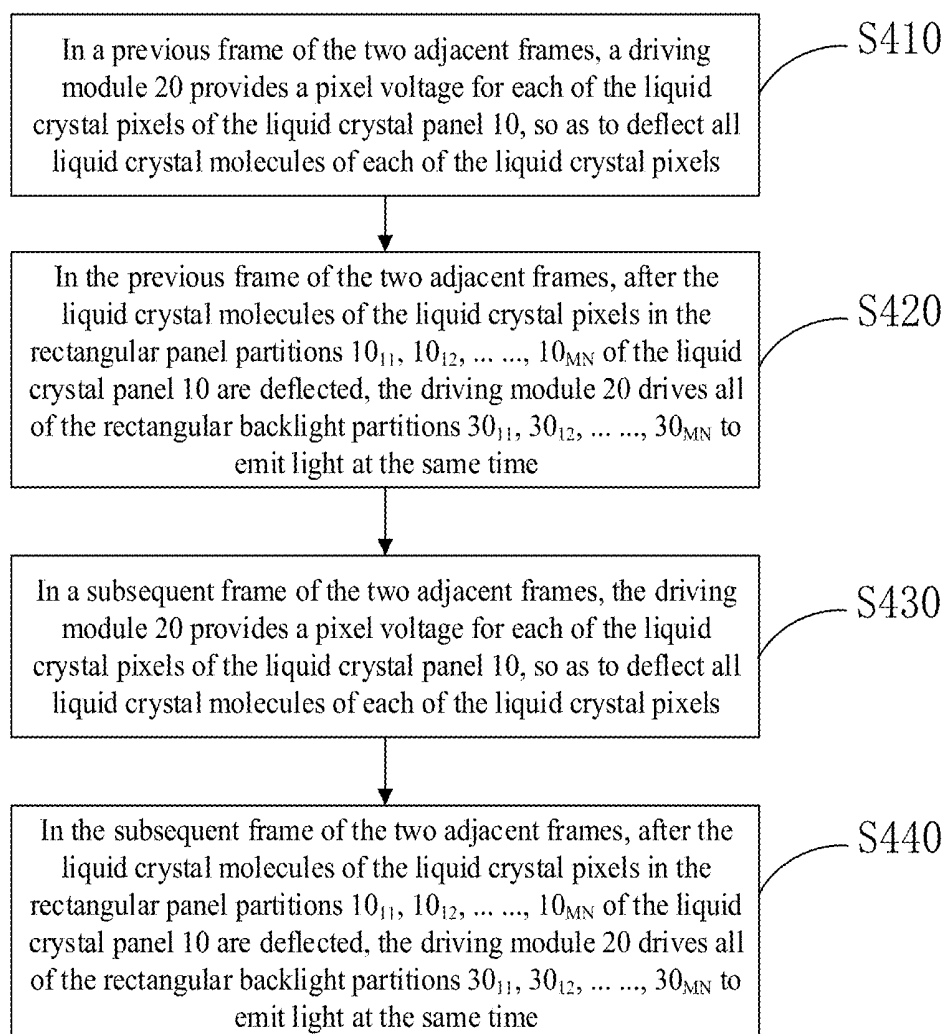


FIG. 4

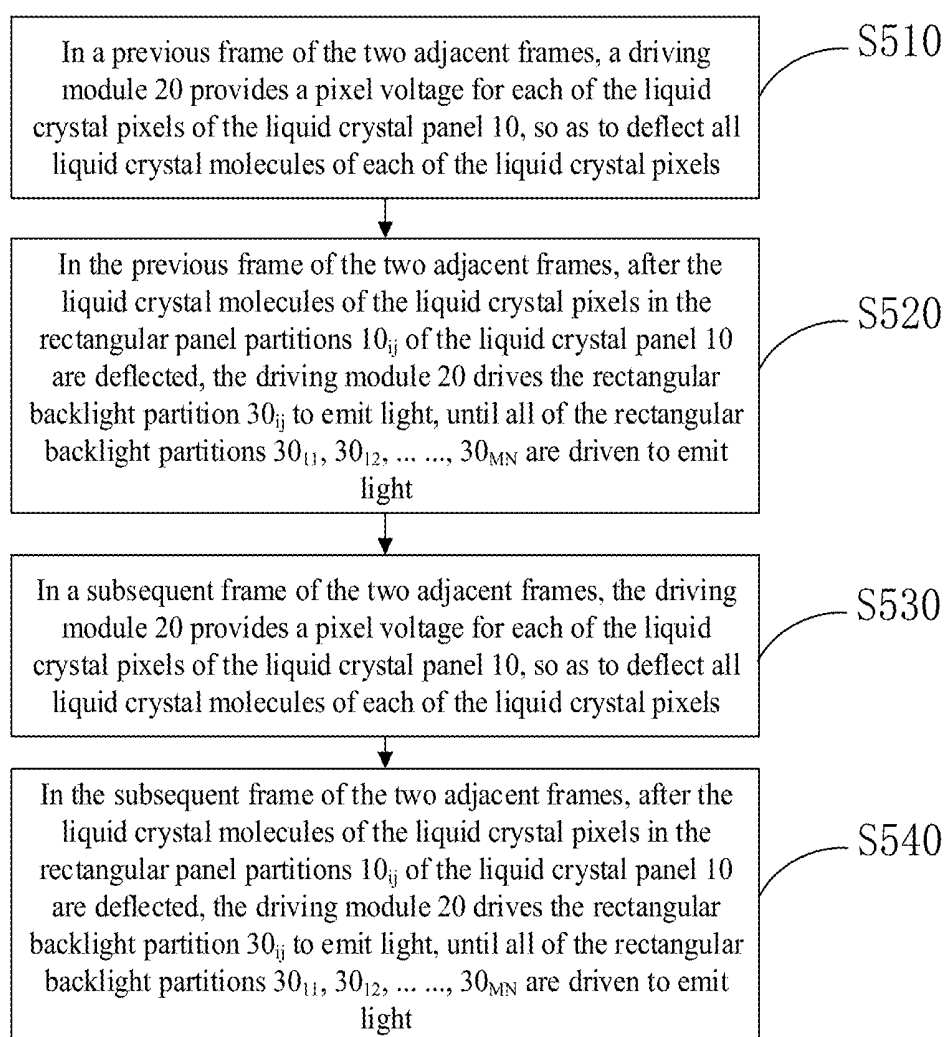


FIG. 5

LIQUID CRYSTAL DISPLAY AND METHOD FOR DRIVING SAME

TECHNICAL FIELD

[0001] The present disclosure relates to the field of display technologies, in particular, to a liquid crystal display and method for driving same.

BACKGROUND

[0002] With the evolution of optoelectronics and semiconductor technologies, Flat Panel Displays have thereby a booming development as well. Among various Flat Panel Displays, Liquid Crystal Displays (LCD) have been applied in various aspects of production and daily life due to a number of advantageous characteristics such as high space utilization efficiency, low power consumption, no radiation, low electromagnetic interference and the like. A liquid crystal display typically includes a liquid crystal panel, a backlight module and a driving module driving the liquid crystal panel and the backlight module, wherein the liquid crystal panel includes a color filter substrate (i.e. CF substrate) and an array substrate which are configured by cell-aligning, and liquid crystals interposed therebetween. Among the existing large dimensioned liquid crystal panels, negative-type VA (Vertically Aligned) liquid crystals are mostly adopted. However, negative-type VA liquid crystals have many deficiencies. Particularly, color shift phenomenon may occur as a liquid crystal panel using negative-type VA type liquid crystals is viewed at a large viewing angle, when desired to present the liquid crystal panel at a large viewing angle.

[0003] To overcome the deficiencies as described above, it tends to further divide respective sub pixels into Main/Sub secondary pixels, and provide different pixel voltages to the Main/Sub secondary pixels. However, such pixel design often requires for adding metal wires and thin-film transistors (TFT) to drive the Main/Sub secondary pixels, which causes the sacrifice of the aperture ratio, resulting in the reduction of transmittance. In order to maintain the original transmittance, it is necessary to increase the luminance of the light emitted by the backlight module, thereby directly increasing the cost of the backlight module.

SUMMARY

[0004] To solve the problem described above, the present disclosure provides a liquid crystal display and a driving method thereof that solve low color shift without affecting aperture ratio.

[0005] The present disclosure provides a liquid crystal display, which includes: a liquid crystal panel, including a plurality of liquid crystal pixels arranged in array and configured to display the same image in two frames spaced by another frame; a driving module, configured to respectively provide different pixel voltages of the same polarity for each of the liquid crystal pixels in two frames spaced by another frame, so as to deflect liquid crystal molecules of each of the liquid crystal pixels, wherein the pixel voltage of each liquid crystal pixel in each of the two frames spaced by another frame is different from the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side.

[0006] Further, the liquid crystal display also includes a backlight module, wherein the liquid crystal panel is divided

into $M \times N$ rectangular panel partitions, the backlight module is divided into $M \times N$ rectangular backlight partitions, $1 \leq i \leq M$, $1 \leq j \leq N$, and the rectangular panel partition of the i -th row and the j -th column corresponds to the rectangular backlight partition of the i -th row and the j -th column. In each of the two frames spaced by another frame, after the liquid crystal molecules of each liquid crystal pixel in each of the rectangular panel partitions are deflected, the driving module is further configured to drive all of the rectangular backlight partitions to emit light at the same time, or in each of the two frames spaced by another frame, after the liquid crystal molecules of each liquid crystal pixel in the rectangular panel partition of the i -th row and the j -th column are deflected, the driving module is further configured to drive the rectangular backlight partition of the i -th row and the j -th column to emit light, until all of the rectangular backlight partitions are driven to emit light.

[0007] Further, the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and j -th column and a luminance of the rectangular backlight partition of the i -th row and j -th column satisfy the following formula 1,

$$L_{ij-1} * V_{ij-1} = L_{ij-2} * V_{ij-2} \quad \text{[Formula 1]}$$

[0008] wherein L_{ij-1} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in the previous frame of two frames spaced by another frame, V_{ij-1} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the previous frame of the two frames spaced by another frame, L_{ij-2} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in the subsequent frame of two frames spaced by another frame, V_{ij-2} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the subsequent frame of the two frames spaced by another frame.

[0009] Further, the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and j -th column and the luminance of the rectangular backlight partition of the i -th row and j -th column satisfy the following formula 2,

$$L_{ij-1} * V_{ij-1} + L_{ij-2} * V_{ij-2} = 2 * L_{ij} * V_{ij} \quad \text{[Formula 2]}$$

[0010] wherein L_{ij} denotes the luminance of the rectangular backlight partition of the i -th row and j -th column when the liquid crystal display is configured to display the image only in one frame, V_{ij} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition when the liquid crystal display is configured to display the image only in one frame, L_{ij-1} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in the previous frame of two frames spaced by another frame, V_{ij-1} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the previous frame of the two frames spaced by another frame, L_{ij-2} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in the subsequent frame of two frames spaced by another frame, V_{ij-2} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the subsequent frame of the two frames spaced by another frame.

[0011] The present disclosure further provides a driving method for a liquid crystal display that includes a liquid crystal panel including a plurality of liquid crystal pixels arranged in array, and a driving module, and the liquid crystal panel is configured to display the same image in two frames spaced by another frame,

[0012] wherein the driving method for the liquid crystal display includes:

[0013] providing, by a driving module, a pixel voltage to each of the liquid crystal pixels in a previous frame of the two frames spaced by another frame, so as to deflect liquid crystal molecules of each of the liquid crystal pixels,

[0014] providing, by the driving module, a pixel voltage to each of the liquid crystal pixels in a subsequent frame of the two frames spaced by another frame, so as to deflect liquid crystal molecules of each of the liquid crystal pixels,

[0015] wherein the pixel voltage of each liquid crystal pixel is different from the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side, and the pixel voltages of the same liquid crystal pixel in the previous frame and in the subsequent frame have the same polarity but are different in values.

[0016] Further, the liquid crystal display also includes a backlight module, wherein the liquid crystal panel is divided into $M \times N$ rectangular panel partitions, the backlight module is divided into $M \times N$ rectangular backlight partitions, $1 \leq i \leq M$, $1 \leq j \leq N$, and the rectangular panel partition of the i -th row and the j -th column corresponds to the rectangular backlight partition of the i -th row and the j -th column.

[0017] The driving method for the liquid crystal display further includes:

[0018] in the previous frame of the two frames spaced by another frame, after the liquid crystal molecules of each liquid crystal pixel in each of the rectangular panel partitions are deflected, driving, by the driving module, all of the rectangular backlight partitions to emit light at the same time, and

[0019] in the subsequent frame of the two frames spaced by another frame, after the liquid crystal molecules of each liquid crystal pixel in each of the rectangular panel partitions are deflected, driving, by the driving module, all of the rectangular backlight partitions to emit light at the same time.

[0020] Alternatively, the driving method for the liquid crystal display further includes:

[0021] in the previous frame of the two frames spaced by another frame, after the liquid crystal molecules of each liquid crystal pixel in the rectangular panel partition of the i -th row and j -th column are deflected, driving, by the driving module, the rectangular backlight partition of the i -th row and j -th column to emit light, until all of the rectangular backlight partitions are driven to emit light, and

[0022] in the subsequent frame of the two frames spaced by another frame, after the liquid crystal molecules of each liquid crystal pixel in the rectangular panel partition of the i -th row and j -th column are deflected, driving, by the driving module, the rectangular backlight partition of the i -th row and j -th column to emit light, until all of the rectangular backlight partitions are driven to emit light.

[0023] Further, the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and j -th column and the luminance of the rectangular backlight partition of the i -th row and j -th column satisfy the

formula 1 and/or the formula 2 as following according to the driving method for the liquid crystal display described above,

$$L_{ij-1} * V_{ij-1} = L_{ij-2} * V_{ij-2} \quad [\text{Formula 1}]$$

$$L_{ij-1} * V_{ij-1} + L_{ij-2} * V_{ij-2} = 2 * L_{ij} * V_{ij} \quad [\text{Formula 2}]$$

[0024] wherein, L_{ij-1} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in the previous frame of two frames spaced by another frame, V_{ij-1} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the previous frame of the two frames spaced by another frame, L_{ij-2} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in the subsequent frame of two frames spaced by another frame, V_{ij-2} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the subsequent frame of the two frames spaced by another frame, L_{ij} denotes the luminance of the rectangular backlight partition of the i -th row and j -th column when the liquid crystal display is configured to display the image only in one frame, and V_{ij} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition when the liquid crystal display is configured to display the image only in one frame.

[0025] The present disclosure provides a liquid crystal display, including: a liquid crystal panel including a plurality of liquid crystal pixels and configured to display the same image in two frames spaced by another frame, wherein the liquid crystal display further includes a backlight module wherein the liquid crystal panel is divided into $M \times N$ rectangular panel partitions, the backlight module is divided into $M \times N$ rectangular backlight partitions, $1 \leq i \leq M$, $1 \leq j \leq N$, and the rectangular panel partition of the i -th row and the j -th column corresponds to the rectangular backlight partition of the i -th row and the j -th column; and a driving module, configured to respectively provide different pixel voltages of the same polarity for each of the liquid crystal pixels in two frames spaced by another frame, so as to deflect liquid crystal molecules of each of the liquid crystal pixels; wherein in each of the two frames spaced by another frame the pixel voltage of each liquid crystal pixel is different from the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side.

[0026] Further, the driving module is further configured to drive the rectangular backlight partition of the i -th row and the j -th column to emit light, until all of the rectangular backlight are driven to emit light.

[0027] Further, the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and j -th column and the luminance of the rectangular backlight partition of the i -th row and j -th column satisfy the following formula 1,

$$L_{ij-1} * V_{ij-1} = L_{ij-2} * V_{ij-2} \quad [\text{Formula 1}]$$

[0028] wherein L_{ij-1} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in the previous frame of two frames spaced by another frame, V_{ij-1} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the previous frame of the two frames spaced by another frame, L_{ij-2} denotes the luminance

of the rectangular backlight partition of the i-th row and the j-th column in the subsequent frame of two frames spaced by another frame, $V_{ij,2}$ denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and the j-th column in the subsequent frame of the two frames spaced by another frame.

[0029] Further, the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and j-th column and the luminance of the rectangular backlight partition of the i-th row and j-th column satisfy the following formula 2,

$$L_{ij,1} * V_{ij,1} + L_{ij,2} * V_{ij,2} = 2 * L_{ij} * V_{ij} \quad [\text{Formula 2}]$$

[0030] wherein L_{ij} denotes the luminance of the rectangular backlight partition of the i-th row and j-th column when the liquid crystal display is configured to display the image only in one frame, V_{ij} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition when the liquid crystal display is configured to display the image only in one frame, $L_{ij,1}$ denotes the luminance of the rectangular backlight partition of the i-th row and the j-th column in the previous frame of two frames spaced by another frame, $V_{ij,1}$ denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and the j-th column in the previous frame of the two frames spaced by another frame, $L_{ij,2}$ denotes the luminance of the rectangular backlight partition of the i-th row and the j-th column in the subsequent frame of two frames spaced by another frame, $V_{ij,2}$ denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and the j-th column in the subsequent frame of the two frames spaced by another frame.

[0031] By means of providing each of the liquid crystal pixels in two frames spaced by another frame with different pixel voltages of the same polarity respectively in the two frames spaced by another frame, and in each of the two frames spaced by another frame, the difference between the pixel voltage of each liquid crystal pixel and the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side, a compensation effect for a viewing angle against low color shift is thereby achieved while the liquid crystal panel displays the same image in the two frames spaced by another frame, i.e. color shift phenomenon may not occur as viewing the liquid crystal panel in a direction of an large viewing angle. Moreover, it may be not necessary to add any metal wires and thin-film transistors to drive Main/Sub secondary pixels, since a liquid crystal pixel is not divided into Main/Sub secondary pixels any more, thus not reducing the aperture ratio. Further, in the previous and subsequent frame of the two frames spaced by another frame, the products of the luminance of each of the rectangular backlight partitions and the sum of the pixel voltages of the liquid crystal pixels in the corresponding rectangular panel partition are equal, so as to equalize the displaying luminance of each of the rectangular panel partitions in the two frames spaced by another frame, and thus flicker phenomenon can be eliminated. Furthermore, the sum of the luminance of the same image displayed in two frames spaced by another frame in each of rectangular panel partitions of the liquid crystal panel is to be twice of the luminance of the image displayed in one frame of the liquid crystal panel without being applied by any compensation effects for a viewing angle against low

color shift, so as to equalize the luminance of the image displayed in the liquid crystal panel with the luminance of the image displayed in the liquid crystal panel without being applied by any compensation effects for a viewing angle against low color shift.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] The above and other aspects, features and advantages of embodiments of the present disclosure will become more apparent from the following description taken in conjunction with the accompanying drawings, in which:

[0033] FIG. 1 is a schematic diagram of a liquid crystal display according to an embodiment of the present disclosure.

[0034] FIG. 2 is a schematic diagram of a liquid crystal display according to another embodiment of the present disclosure.

[0035] FIG. 3 is a flow chart of a driving method for the liquid crystal display shown in FIG. 1.

[0036] FIG. 4 is a flow chart of a driving method for the liquid crystal display shown in FIG. 2.

[0037] FIG. 5 is a flow chart of another driving method for the liquid crystal display shown in FIG. 2.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0038] Embodiments of the invention are described more fully hereinafter with reference to the accompanying drawings. The various embodiments of the invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

[0039] FIG. 1 is a schematic diagram of a liquid crystal display according to an embodiment of the present disclosure.

[0040] Referring to FIG. 1, the liquid crystal display according to the embodiment of the present disclosure includes: a liquid crystal panel 10, a driving module 20, and a backlight module 30.

[0041] The liquid crystal panel 10 may include a color filter substrate (i.e. CF substrate), an array substrate which are configured by cell-aligning, and negative-type VA liquid crystals interposed therebetween. In other words, the liquid crystal panel 10 is a liquid crystal panel having a VA displaying mode. Furthermore, the specific structures of the color filter substrate and the array substrate and how that the liquid crystal panel 10 is constituted by the color filter substrate, the array substrate, and a negative VA liquid crystal will not be described hereto.

[0042] In the process of assembling the liquid crystal display, the liquid crystal panel 10 and the backlight module 30 are configured to face each other, and the liquid crystal panel 10 and the backlight module 30 are fixed by a fixing means such as an outer frame. The driving module 20 drives backlight module 30 to emit light for the liquid crystal panel 10. In FIG. 1, in order to facilitate the description of the embodiment, the assembled state of the liquid crystal panel 10 and the backlight module 30 is not shown.

[0043] The liquid crystal panel 10 includes AxB liquid crystal pixels (i.e. sub pixels) $P_{11}, P_{12}, \dots, P_{AB}$. The liquid crystal pixel P_{ab} (wherein $1 \leq a \leq A$, $1 \leq b \leq B$, and a, b are both

an integer) may be a red liquid crystal pixel, a green liquid crystal pixel or a blue liquid crystal pixel, but the present disclosure is not limited thereto. Moreover, at least a red liquid crystal pixel, at least a green liquid crystal pixel and at least a blue liquid crystal pixel must be included in these liquid crystal pixels $P_{11}, P_{12}, \dots, P_{AB}$. As a preferred embodiment, the liquid crystal pixels arranged in a column direction are all in the same color, while a red liquid crystal pixel, a green liquid crystal pixel and a blue liquid crystal pixel are arranged sequentially in a row direction by groups.

[0044] In the liquid crystal panel **10** of this embodiment, it is not necessary to divide each liquid crystal pixel into Main/Sub secondary pixels any more. To avoid color shift phenomenon as viewing the liquid crystal panel **10** at an large viewing angle, the technical solution adopted in the embodiment is that: the liquid crystal panel **10** is configured to display the same image in two frames spaced by another frame; the driving module **20** provide different pixel voltages of the same polarity for each of the liquid crystal pixels in two frames spaced by another frame, so as to deflect liquid crystal molecules of each of the liquid crystal pixels; and the pixel voltage of each liquid crystal pixel in each of the two frames spaced by another frame is different from the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side.

[0045] In other words, the frame refresh frequency of the liquid crystal panel **10** is doubled. For example, the frame refresh frequency of the liquid crystal panel **10** is 120 Hz. The specific method for improving the frame refresh frequency can refer to the related content of the prior art, which will not be described hereto.

[0046] The technical solution adopted in the embodiment described above will be further set forth hereinafter.

[0047] Further referring to FIG. 1, in the previous frame of the two frames spaced by another frame, the driving module **20** provides a high pixel voltage (or a low pixel voltage) for the liquid crystal pixel P_{ab} , so as to deflect the liquid crystal molecules of the liquid crystal pixel P_{ab} , while the driving module **20** provides low pixel voltages (or high pixel voltages) respectively for the liquid crystal pixel $P_{(a-1)b}$, the liquid crystal pixel $P_{a(b-1)}$, the liquid crystal pixel $P_{a(b+1)}$ and the liquid crystal pixel $P_{(a+1)b}$.

[0048] In the subsequent frame of the two frames spaced by another frame, the driving module **20** provides a low pixel voltage (or a high pixel voltage) for the liquid crystal pixel P_{ab} , so as to deflect the liquid crystal molecules of the liquid crystal pixel P_{ab} , while the driving module **20** provides high pixel voltages (or low pixel voltages) respectively for the liquid crystal pixel $P_{(a-1)b}$, the liquid crystal pixel $P_{a(b-1)}$, the liquid crystal pixel $P_{a(b+1)}$ and the liquid crystal pixel $P_{(a+1)b}$.

[0049] In other words, the pixel voltage of each liquid crystal pixel is different from the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side, and the values of the pixel voltages provided to each of the liquid crystal pixels in the previous frame and the subsequent frame of the two frames spaced by another frame are different. It should be noted that the polarities of the high pixel voltages and the low pixel voltages are the same, so that the liquid crystal panel **10** can display the same image in the previous frame and the subsequent frame of the two frames spaced by another frame.

[0050] Furthermore, the high pixel voltages and the low pixel voltages, which are in general recorded in the driving module **10** in form of Look Up Table (LUT), are determined in advance according to the inputted RGP signals and the viewing angle effect to be compensated as needed. For example, taking an 8-bit drive signal as an example, each set of the inputted RGB signals corresponds to 256 high and low pixel voltages, so that there are 3×256 high pixel voltages and 3×256 low pixel voltages in total.

[0051] In summary, by means of providing each of the liquid crystal pixels in two frames spaced by another frame with different pixel voltages of the same polarity respectively in the two frames spaced by another frame, and in each of the two frames spaced by another frame, the difference between the pixel voltage of each liquid crystal pixel and the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side, a compensation effect for a viewing angle against low color shift is thereby achieved while the liquid crystal panel **10** displays the same image in the two frames spaced by another frame, i.e. color shift phenomenon may not occur as viewing the liquid crystal panel in a direction of an large viewing angle.

[0052] Furthermore, in order to overcome discomfort flicker phenomenon caused by the uneven luminance displayed by each of the liquid crystal pixels of the liquid crystal panel in the two frames spaced by another frame, the backlight module **30** is divided by luminance region. By dynamically adjusting the luminance of each luminance region, the luminance of each liquid crystal pixel of the liquid crystal panel **10** is even, thereby eliminating flicker. More details refer to the liquid crystal display shown in FIG. 2. FIG. 2 is a schematic view of a liquid crystal display according to another embodiment of the present disclosure. In the following, only the differences between the embodiment shown in FIG. 2 and the embodiment shown in FIG. 1 will be described.

[0053] Referring to FIG. 2, different to the embodiment shown in FIG. 1, the liquid crystal panel **10** is divided into $M \times N$ rectangular panel partitions $10_{11}, 10_{12}, \dots, 10_{MN}$, and the backlight module **30** is divided into $M \times N$ rectangular backlight partitions $30_{11}, 30_{12}, \dots, 30_{MN}$, wherein the rectangular panel partition 10_{ij} corresponds to the rectangular backlight partition 30_{ij} , $1 \leq i \leq M$, $1 \leq j \leq N$, and i, j both are an integer. Here, it should be noted that the number of liquid crystal pixels included in the rectangular panel partition 10_{ij} is the same, but may be also different from other embodiments.

[0054] In such a way, the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition 10_{ij} and the luminance of the rectangular backlight partition 30_{ij} satisfy the following formula 1,

$$L_{ij-1} * V_{ij-1} = L_{ij-2} * V_{ij-2} \quad [\text{Formula 1}]$$

[0055] wherein L_{ij-1} denotes the luminance of the rectangular panel partition 10_{ij} in the previous frame of the two frames spaced by another frame, V_{ij-1} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition 10_{ij} in the previous frame of the two frames spaced by another frame, L_{ij-2} denotes the luminance of the rectangular backlight partition 30_{ij} in the subsequent frame of the two frames spaced by another frame, and V_{ij-2} denotes the sum of the pixel voltages of the liquid crystal pixels in

the rectangular panel partition 30_{ij} in the subsequent frame of the two frames spaced by another frame.

[0056] Here, since the pixel voltage of the liquid crystal pixel is proportional to the light transmittance of the liquid crystal pixel, the product of the light transmittance of the liquid crystal pixel and the backlight luminance is the display luminance of the liquid crystal pixel, that is, the product of the pixel voltage of the liquid crystal pixel and the backlight luminance can represent the display luminance of the liquid crystal pixel. When the products of the luminance of the rectangular backlight partition 30_{ij} and the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition 10_{ij} in the previous frame and the subsequent frame of the two frames spaced by another frame are equal to each other, the display luminance of the rectangular panel partition 10_{ij} in the previous frame and the subsequent frame of the two frames spaced by another frame are equal to each other, so as to eliminate flicker phenomenon.

[0057] After the liquid crystal panel 10 and the backlight module 30 are both divided into partitions, the method in which the backlight module 30 provides display light to the liquid crystal panel 10 may include the following two methods, of course, the two methods described below are merely examples, and the present disclosure may further include other suitable methods.

[0058] The first method that the backlight module 30 provides display light to the liquid crystal panel 10 is that: in each of the two frames spaced by another frame, after the liquid crystal molecules of the liquid crystal pixels in all of the rectangular panel partitions 10_{11} , 10_{12} , $\dots$, 10_{MN} are deflected, the driving module 20 drives all of the rectangular backlight partitions 30_{11} , 30_{12} , $\dots$, 30_{MN} to emit light. Of course, it should be understood that the luminance of all of the rectangular backlight partitions which are regulated respectively by the driving module 20 may be different or also be the same.

[0059] The second method that the backlight module 30 provides display light to the liquid crystal panel 10 is that: in each of the two frames spaced by another frame, after the liquid crystal molecules of the liquid crystal pixels in the rectangular panel partition 10_{ij} are deflected, the driving module 20 drives the rectangular backlight partition 30_{ij} to emit light, until all of the rectangular backlight partitions 30_{11} , 30_{12} , $\dots$, 30_{MN} are driven to emit light. In other words, the driving module 20 drives each of the rectangular backlight partitions over time. Of course, it should be understood that the luminance of all of the rectangular backlight partitions which are regulated respectively by the driving module 20 may be different or also be the same.

[0060] Furthermore, in order to equalize the luminance of the image displayed on the liquid crystal panel 10 with the luminance of the image displayed on the liquid crystal panel without being applied by the compensation effect for a viewing angle against low color shift, the sum of the luminance of the same image displayed in two frames spaced by another frame in each of rectangular panel partitions of the liquid crystal panel 10 is to be twice of the luminance of the image displayed in one frame of the liquid crystal panel without being applied by any compensation effects for a viewing angle against low color shift. The specific technical solution is described as below.

[0061] The sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition 10_{ij} and the luminance of the rectangular backlight partition 30_{ij} satisfy the following formula 2,

$$L_{ij-1} * V_{ij-1} + L_{ij-2} * V_{ij-2} = 2 * L_{ij} * V_{ij} \quad [\text{Formula 2}]$$

[0062] wherein L_{ij} denotes the luminance of the corresponding rectangular backlight partition when the liquid crystal panel without being applied by any compensation for a viewing angle against low color shift is configured to display the image in only one frame, V_{ij} denotes the sum of the pixel voltages of the liquid crystal pixels in the corresponding rectangular panel partition when the liquid crystal panel without being applied by any compensation for a viewing angle against low color shift is configured to display the image in only one frame. It should be noted that the images displayed in different frames of the liquid crystal panel without being applied by any compensation for a viewing angle against low color shift are different.

[0063] The driving method for the liquid crystal display will be described below. FIG. 3 is a flow chart of the driving method for the liquid crystal display shown in FIG. 1.

[0064] Referring to FIG. 1 and FIG. 3, the driving method for a liquid crystal display according to the embodiment of the present disclosure includes:

[0065] In step S310, in a previous frame of the two frames spaced by another frame, a driving module 20 provides a pixel voltage for each of the liquid crystal pixels of the liquid crystal panel 10, so as to deflect all liquid crystal molecules of each of the liquid crystal pixels.

[0066] In step S320, in a subsequent frame of the two frames spaced by another frame, the driving module 20 provides a pixel voltage for each of the liquid crystal pixels of the liquid crystal panel 10, so as to deflect all liquid crystal molecules of each of the liquid crystal pixels.

[0067] Wherein in the previous frame and the subsequent frame, the pixel voltage of each liquid crystal pixel is different from the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side, and the pixel voltages of the same liquid crystal pixel have the same polarity but are different in values.

[0068] FIG. 4 is a flow chart of the driving method for the liquid crystal display shown in FIG. 2.

[0069] Referring to FIG. 2 and FIG. 4, the driving method for the liquid crystal display according to the embodiment of the present disclosure includes:

[0070] In step S410, in a previous frame of the two frames spaced by another frame, a driving module 20 provides a pixel voltage for each of the liquid crystal pixels of the liquid crystal panel 10, so as to deflect all liquid crystal molecules of each of the liquid crystal pixels.

[0071] In step S420, in the previous frame of the two frames spaced by another frame, after the liquid crystal molecules of the liquid crystal pixels in the rectangular panel partitions 10_{11} , 10_{12} , $\dots$, 10_{MN} of the liquid crystal panel 10 are deflected, the driving module 20 drives all of the rectangular backlight partitions 30_{11} , 30_{12} , $\dots$, 30_{MN} to emit light at the same time.

[0072] In step S430, in a subsequent frame of the two frames spaced by another frame, the driving module 20 provides a pixel voltage for each of the liquid crystal pixels of the liquid crystal panel 10, so as to deflect all liquid crystal molecules of each of the liquid crystal pixels.

[0073] In step S440, in the subsequent frame of the two frames spaced by another frame, after the liquid crystal molecules of the liquid crystal pixels in the rectangular panel partitions $10_{11}, 10_{12}, \dots, 10_{MN}$ of the liquid crystal panel 10 are deflected, the driving module 20 drives all of the rectangular backlight partitions $30_{11}, 30_{12}, \dots, 30_{MN}$ to emit light at the same time.

[0074] Wherein in the previous frame and the subsequent frame, the pixel voltage of each liquid crystal pixel is different from the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side, and the pixel voltages of the same liquid crystal pixel have the same polarity but are different in values.

[0075] FIG. 5 is a flow chart of another driving method for the liquid crystal display shown in FIG. 2.

[0076] Referring to FIG. 2 and FIG. 4, the driving method for the liquid crystal display according to the embodiment of the present disclosure includes:

[0077] In step S510, in a previous frame of the two frames spaced by another frame, a driving module 20 provides a pixel voltage for each of the liquid crystal pixels of the liquid crystal panel 10, so as to deflect all liquid crystal molecules of each of the liquid crystal pixels.

[0078] In step S520, in the previous frame of the two frames spaced by another frame, after the liquid crystal molecules of the liquid crystal pixels in the rectangular panel partitions 10_{ij} of the liquid crystal panel 10 are deflected, the driving module 20 drives the rectangular backlight partition 30_{ij} to emit light, until all of the rectangular backlight partitions $30_{11}, 30_{12}, \dots, 30_{MN}$ are driven to emit light.

[0079] In step S530, in a subsequent frame of the two frames spaced by another frame, the driving module 20 provides a pixel voltage for each of the liquid crystal pixels of the liquid crystal panel 10, so as to deflect all liquid crystal molecules of each of the liquid crystal pixels.

[0080] In step S540, in the subsequent frame of the two frames spaced by another frame, after the liquid crystal molecules of the liquid crystal pixels in the rectangular panel partitions 10_{ij} of the liquid crystal panel 10 are deflected, the driving module 20 drives the rectangular backlight partition 30_{ij} to emit light, until all of the rectangular backlight partitions $30_{11}, 30_{12}, \dots, 30_{MN}$ are driven to emit light.

[0081] Wherein in the previous frame and the subsequent frame, the pixel voltage of each liquid crystal pixel is different from the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side, and the pixel voltages of the same liquid crystal pixel have the same polarity but are different in values.

[0082] Moreover, in the driving method shown in FIG. 4 and FIG. 5, the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition 10_{ij} and the luminance of the rectangular backlight partition 30_{ij} further satisfy the formula 1 and/or formula 2 above.

[0083] In summary, by means of providing each of the liquid crystal pixels in two frames spaced by another frame with different pixel voltages of the same polarity respectively in the two frames spaced by another frame, and in each of the two frames spaced by another frame, the difference between the pixel voltage of each liquid crystal pixel and the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side, a compensation effect for a viewing

angle against low color shift is thereby achieved while the liquid crystal panel displays one same image in the two frames spaced by another frame, i.e. color shift phenomenon may not occur as viewing the liquid crystal panel in a direction of a large viewing angle. Moreover, it is not necessary to add any metal wires and thin-film transistors to drive Main/Sub secondary pixels, since a liquid crystal pixel is not divided into Main/Sub secondary pixels any more, thus not reducing the aperture ratio. Further, the products of the luminance of each of the rectangular backlight partitions and the sum of the pixel voltages of the liquid crystal pixels in the corresponding rectangular panel partition in the previous and subsequent frame of the two frames spaced by another frame are equalized, so as to equalize the displaying luminance of each of the rectangular panel partitions in the two frames spaced by another frame, and thus flicker phenomenon can be eliminated. Furthermore, the sum of the luminance of the same image displayed in two frames spaced by another frame in each of rectangular panel partitions of the liquid crystal panel is to be twice of the luminance of the image displayed in one frame of the liquid crystal panel without being applied by any compensation effects for a viewing angle against low color shift, so as to equalize the luminance of the image displayed in the liquid crystal panel with the luminance of the image displayed in the liquid crystal panel without being applied by any compensation effects for a viewing angle against low color shift.

[0084] Although the present disclosure has been shown and described with reference to specific embodiments, those skilled in the art will appreciate that various changes in form and detail may be made herein without departing from the spirit and scope of the invention as defined by the claims and their equivalents.

1. A liquid crystal display, comprising:

- a liquid crystal panel comprising a plurality of liquid crystal pixels and configured to display the same image in two frames spaced by another frame; and
- a driving module configured to respectively provide different pixel voltages of the same polarity for each of the liquid crystal pixels in the two frames spaced by another frame, so as to deflect liquid crystal molecules of each of the liquid crystal pixels;

wherein in each frame of the two frames spaced by another frame, the pixel voltage of each liquid crystal pixel is different from the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side.

2. The liquid crystal display of claim 1, wherein the liquid crystal display further comprises a backlight module, the liquid crystal panel is divided into $M \times N$ rectangular panel partitions, the backlight module is divided into $M \times N$ rectangular backlight partitions, $1 \leq i \leq M$, $1 \leq j \leq N$, and the rectangular panel partition of the i -th row and the j -th column corresponds to the rectangular backlight partition of the i -th row and the j -th column;

in each frame of the two frames spaced by another frame, after the liquid crystal molecules of each liquid crystal pixel in each of the rectangular panel partitions are deflected, the driving module is configured to drive all of the rectangular backlight partitions to emit light at the same time.

3. The liquid crystal display of claim 1, wherein the liquid crystal display further comprises a backlight module, the liquid crystal panel is divided into $M \times N$ rectangular panel

partitions, the backlight module is divided into $M \times N$ rectangular backlight partitions, $1 \leq i \leq M$, $1 \leq j \leq N$, and the rectangular panel partition of the i -th row and the j -th column corresponds to the rectangular backlight partition of the i -th row and the j -th column;

in each frame of the two frames spaced by another frame, after the liquid crystal molecules of each liquid crystal pixel in the rectangular panel partition of the i -th row and j -th column are deflected, the driving module is further configured to drive the rectangular backlight partition of the i -th row and j -th column to emit light, until all of the rectangular backlight partitions are driven to emit light.

4. The liquid crystal display of claim 2, wherein a sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and j -th column, and luminance of the rectangular backlight partition of the i -th row and j -th column satisfy the following formula 1,

$$L_{ij-1} * V_{ij-1} = L_{ij-2} * V_{ij-2} \quad [\text{Formula 1}]$$

wherein L_{ij-1} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in a previous frame of two frames spaced by another frame, V_{ij-1} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the previous frame of the two frames spaced by another frame, L_{ij-2} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in a subsequent frame of two frames spaced by another frame, V_{ij-2} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the subsequent frame of the two frames spaced by another frame.

5. The liquid crystal display of claim 3, wherein a sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and j -th column and luminance of the rectangular backlight partition of the i -th row and j -th column satisfy the following formula 1,

$$L_{ij-1} * V_{ij-1} = L_{ij-2} * V_{ij-2} \quad [\text{Formula 1}]$$

wherein L_{ij-1} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in a previous frame of two frames spaced by another frame, V_{ij-1} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the previous frame of the two frames spaced by another frame, L_{ij-2} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in a subsequent frame of two frames spaced by another frame, V_{ij-2} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the subsequent frame of the two frames spaced by another frame.

6. The liquid crystal display of claim 2, wherein a sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and j -th column and luminance of the rectangular backlight partition of the i -th row and j -th column satisfy the following formula 2,

$$L_{ij-1} * V_{ij-1} + L_{ij-2} * V_{ij-2} = 2 * L_{ij} * V_{ij} \quad [\text{Formula 2}]$$

wherein L_{ij} denotes the luminance of the rectangular backlight partition of the i -th row and j -th column when the liquid crystal display is configured to display the

image only in one frame, V_{ij} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition when the liquid crystal display is configured to display the image only in one frame, L_{ij-1} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in a previous frame of two frames spaced by another frame, V_{ij-1} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in a previous frame of the two frames spaced by another frame, L_{ij-2} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in the subsequent frame of two frames spaced by another frame, V_{ij-2} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the subsequent frame of the two frames spaced by another frame.

7. The liquid crystal display of claim 3, wherein a sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and j -th column and luminance of the rectangular backlight partition of the i -th row and j -th column satisfy the following formula 2,

$$L_{ij-1} * V_{ij-1} + L_{ij-2} * V_{ij-2} = 2 * L_{ij} * V_{ij} \quad [\text{Formula 2}]$$

wherein L_{ij} denotes the luminance of the rectangular backlight partition of the i -th row and j -th column when the liquid crystal display is configured to display the image only in one frame, V_{ij} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition when the liquid crystal display is configured to display the image only in one frame, L_{ij-1} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in a previous frame of two frames spaced by another frame, V_{ij-1} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the previous frame of the two frames spaced by another frame, L_{ij-2} denotes the luminance of the rectangular backlight partition of the i -th row and the j -th column in a subsequent frame of two frames spaced by another frame, V_{ij-2} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and the j -th column in the subsequent frame of the two frames spaced by another frame.

8. The liquid crystal display of claim 2, wherein the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and j -th column and the luminance of the rectangular backlight partition of the i -th row and j -th column satisfy the following formula 2

$$L_{ij-1} * V_{ij-1} + L_{ij-2} * V_{ij-2} = 2 * L_{ij} * V_{ij} \quad [\text{Formula 2}]$$

wherein L_{ij} denotes the luminance of the rectangular backlight partition of the i -th row and j -th column when the liquid crystal display is configured to display the image only in one frame, and V_{ij} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition when the liquid crystal display is configured to display the image only in one frame.

9. The liquid crystal display of claim 3, wherein the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i -th row and j -th column

and the luminance of the rectangular backlight partition of the i-th row and j-th column satisfy the following formula 2,

$$L_{ij,1} * V_{ij,1} + L_{ij,2} * V_{ij,2} = 2 * L_{ij} * V_{ij} \quad [\text{Formula 2}]$$

wherein L_{ij} denotes the luminance of the rectangular backlight partition of the i-th row and j-th column when the liquid crystal display is configured to display the image only in one frame, and V_{ij} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition when the liquid crystal display is configured to display the image only in one frame.

10. A driving method for a liquid crystal display, comprising:

in a previous frame of two frames spaced by another frame, providing, by a driving module, a pixel voltage to each of liquid crystal pixels of a liquid crystal panel, so as to deflect liquid crystal molecules of each of the liquid crystal pixels, wherein the liquid crystal panel is configured to display the same image in the two frames spaced by another frame; and

in a subsequent frame of the two frames spaced by another frame, providing, by the driving module, a pixel voltage to each of the liquid crystal pixels of the liquid crystal panel, so as to deflect liquid crystal molecules of each of the liquid crystal pixels,

wherein the pixel voltage of each liquid crystal pixel is different from the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side, and the pixel voltages of the same liquid crystal pixel in the previous frame and in the subsequent frame have the same polarity but are different in values.

11. The driving method for the liquid crystal display of claim 10, wherein the liquid crystal display further comprises a backlight module, wherein the liquid crystal panel is divided into M×N rectangular panel partitions, the backlight module is divided into M×N rectangular backlight partitions, $1 \leq i \leq M$, $1 \leq j \leq N$, and the rectangular panel partition of the i-th row and the j-th column corresponds to the rectangular backlight partition of the i-th row and the j-th column,

wherein the driving method for the liquid crystal display further comprises:

in the previous frame of the two frames spaced by another frame, after the liquid crystal molecules of each liquid crystal pixel in each of the rectangular panel partitions are deflected, driving, by the driving module, all of the rectangular backlight partitions to emit light at the same time, and

in the subsequent frame of the two frames spaced by another frame, after the liquid crystal molecules of each liquid crystal pixel in each of the rectangular panel partitions are deflected, driving, by the driving module drives, all of the rectangular backlight partitions to emit light at the same time.

12. The driving method for the liquid crystal display of claim 10, wherein the liquid crystal display further comprises a backlight module, the liquid crystal panel is divided into M×N rectangular panel partitions, the backlight module is divided into M×N rectangular backlight partitions, $1 \leq i \leq M$, $1 \leq j \leq N$, and the rectangular panel partition of the i-th row and the j-th column corresponds to the rectangular backlight partition of the i-th row and the j-th column,

wherein the driving method for the liquid crystal display further comprises:

in the previous frame of the two frames spaced by another frame, after the liquid crystal molecules of each liquid crystal pixel in the rectangular panel partition of the i-th row and j-th column are deflected, driving, by the driving module, the rectangular backlight partition of the i-th row and j-th column to emit light, until all of the rectangular backlight partitions are driven to emit light, and

in the subsequent frame of the two frames spaced by another frame, after the liquid crystal molecules of each liquid crystal pixel in the rectangular panel partition of the i-th row and j-th column are deflected, driving, by the driving module, the rectangular backlight partition of the i-th row and j-th column to emit light, until all of the rectangular backlight partitions are driven to emit light.

13. The driving method for the liquid crystal display of claim 11, wherein a sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and j-th column and luminance of the rectangular backlight partition of the i-th row and j-th column satisfy the formula 1 and/or the formula 2 as following,

$$L_{ij,1} * V_{ij,1} = L_{ij,2} * V_{ij,2} \quad [\text{Formula 1}]$$

$$L_{ij,1} * V_{ij,1} + L_{ij,2} * V_{ij,2} = 2 * L_{ij} * V_{ij} \quad [\text{Formula 2}]$$

wherein, $L_{ij,1}$ denotes the luminance of the rectangular backlight partition of the i-th row and the j-th column in the previous frame of two frames spaced by another frame, $V_{ij,1}$ denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and the j-th column in the previous frame of the two frames spaced by another frame, $L_{ij,2}$ denotes the luminance of the rectangular backlight partition of the i-th row and the j-th column in the subsequent frame of two frames spaced by another frame, $V_{ij,2}$ denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and the j-th column in the subsequent frame of the two frames spaced by another frame, L_{ij} denotes the luminance of the rectangular backlight partition of the i-th row and j-th column when the liquid crystal display is configured to display the image only in one frame, and V_{ij} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition when the liquid crystal display is configured to display the image only in one frame.

14. The driving method for the liquid crystal display of claim 12, wherein a sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and j-th column and luminance of the rectangular backlight partition of the i-th row and j-th column satisfy the formula 1 and/or the formula 2 as following,

$$L_{ij,1} * V_{ij,1} = L_{ij,2} * V_{ij,2} \quad [\text{Formula 1}]$$

$$L_{ij,1} * V_{ij,1} + L_{ij,2} * V_{ij,2} = 2 * L_{ij} * V_{ij} \quad [\text{Formula 2}]$$

wherein, $L_{ij,1}$ denotes the luminance of the rectangular backlight partition of the i-th row and the j-th column in the previous frame of two frames spaced by another frame, $V_{ij,1}$ denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and the j-th column in the previous

frame of the two frames spaced by another frame, $L_{ij,2}$ denotes the luminance of the rectangular backlight partition of the i-th row and the j-th column in the subsequent frame of two frames spaced by another frame, $V_{ij,2}$ denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and the j-th column in the subsequent frame of the two frames spaced by another frame, L_{ij} denotes the luminance of the rectangular backlight partition of the i-th row and j-th column when the liquid crystal display is configured to display the image only in one frame, and V_{ij} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition when the liquid crystal display is configured to display the image only in one frame.

15. A liquid crystal display, comprising:

a liquid crystal panel comprising a plurality of liquid crystal pixels and configured to display the same image in two frames spaced by another frame, wherein the liquid crystal display further comprises a backlight module, the liquid crystal panel is divided into $M \times N$ rectangular panel partitions, the backlight module is divided into $M \times N$ rectangular backlight partitions, $1 \leq i \leq M$, $1 \leq j \leq N$, and the rectangular panel partition of the i-th row and the j-th column corresponds to the rectangular backlight partition of the i-th row and the j-th column, and

a driving module configured to respectively provide different pixel voltages of the same polarity for each of the liquid crystal pixels in two frames spaced by another frame, so as to deflect liquid crystal molecules of each of the liquid crystal pixels, and after the liquid crystal molecules of each liquid crystal pixel in each of the rectangular panel partitions are deflected, the driving module further configured to drive all of the rectangular backlight partitions to emit light at the same time, wherein in each of the two frames spaced by another frame, the pixel voltage of each liquid crystal pixel is different from the pixel voltages of the liquid crystal pixel adjacent thereto from the upper side, the lower side, the left side and the right side.

16. The liquid crystal display of claim 15, wherein the driving module is further configured to drive all of the rectangular backlight partitions to emit light at the same time.

17. The liquid crystal display of claim 15, wherein the driving module is further configured to drive the rectangular backlight partition of the i-th row and the j-th column to emit light, until all of the rectangular backlight partitions are driven to emit light.

18. The liquid crystal display of claim 16, wherein a sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and j-th column and luminance of the rectangular backlight partition of the i-th row and j-th column satisfy the following formula 1,

$$L_{ij,1} * V_{ij,1} = L_{ij,2} * V_{ij,2} \quad [\text{Formula 1}]$$

wherein $L_{ij,1}$ denotes the luminance of the rectangular backlight partition of the i-th row and the j-th column in a previous frame of two frames spaced by another frame, $V_{ij,1}$ denotes the sum of the pixel voltages of the

liquid crystal pixels in the rectangular panel partition of the i-th row and the j-th column in the previous frame of the two frames spaced by another frame, $L_{ij,2}$ denotes the luminance of the rectangular backlight partition of the i-th row and the j-th column in a subsequent frame of two frames spaced by another frame, $V_{ij,2}$ denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and the j-th column in the subsequent frame of the two frames spaced by another frame.

19. The liquid crystal display of claim 17, wherein a sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and j-th column and luminance of the rectangular backlight partition of the i-th row and j-th column satisfy the following formula 1,

$$L_{ij,1} * V_{ij,1} = L_{ij,2} * V_{ij,2} \quad [\text{Formula 1}]$$

wherein, $L_{ij,1}$ denotes the luminance of the rectangular backlight partition of the i-th row and the j-th column in the previous frame of two frames spaced by another frame, $V_{ij,1}$ denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and the j-th column in a previous frame of the two frames spaced by another frame, $L_{ij,2}$ denotes the luminance of the rectangular backlight partition of the i-th row and the j-th column in the subsequent frame of two frames spaced by another frame, $V_{ij,2}$ denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and the j-th column in a subsequent frame of the two frames spaced by another frame.

20. The liquid crystal display of claim 15, wherein a sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and j-th column and luminance of the rectangular backlight partition of the i-th row and j-th column satisfy the following formula 2,

$$L_{ij,1} * V_{ij,1} + L_{ij,2} * V_{ij,2} = 2 * L_{ij} * V_{ij} \quad [\text{Formula 2}]$$

wherein, L_{ij} denotes the luminance of the rectangular backlight partition of the i-th row and j-th column when the liquid crystal display is configured to display the image only in one frame, and V_{ij} denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition when the liquid crystal display is configured to display the image only in one frame, $L_{ij,1}$ denotes the luminance of the rectangular backlight partition of the i-th row and the j-th column in a previous frame of two frames spaced by another frame, $V_{ij,1}$ denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and the j-th column in the previous frame of the two frames spaced by another frame, $L_{ij,2}$ denotes the luminance of the rectangular backlight partition of the i-th row and the j-th column in the subsequent frame of two frames spaced by another frame, $V_{ij,2}$ denotes the sum of the pixel voltages of the liquid crystal pixels in the rectangular panel partition of the i-th row and the j-th column in a subsequent frame of the two frames spaced by another frame.

* * * * *

专利名称(译)	液晶显示器及其驱动方法		
公开(公告)号	US20190311686A1	公开(公告)日	2019-10-10
申请号	US16/309048	申请日	2017-12-26
[标]申请(专利权)人(译)	惠科股份有限公司 重庆惠科金渝光电科技有限公司		
[标]发明人	CHEN YU JEN		
发明人	CHEN, YU-JEN		
IPC分类号	G09G3/34 G09G3/36		
CPC分类号	G09G3/3677 G09G2320/062 G09G3/3426 G09G2310/0254 G09G3/3611 G09G2320/0626 G02F1/1362 G02F2001/133601 G09G3/3648 G09G2320/0233 G09G2320/0242 G09G2320/0686 G09G2340/16 G02F1/13306 G02F1/133308 G02F1/133514 G02F1/133611 G02F1/133753 G02F1/1368 G02F2201/52 G09G3/3406 G09G3/3607 G09G3/3614 G09G3/3666 G09G3/367 G09G2320/0247 G09G2320/0666		
优先权	201611227794.0 2016-12-27 CN		
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摘要(译)

公开了一种液晶显示器，其包括液晶面板 10 和驱动模块 20。。液晶面板10包括多个液晶像素P_{ab} 排列在一个数组中。液晶显示器被配置为在被一帧隔开的两帧中显示相同的图片。驱动模块 20 用于向由一帧分隔的两帧中的每个液晶像素分别提供相同极性的不同像素电压，以偏转每个液晶像素的液晶分子。在由一帧隔开的两个帧的每一个中，每个液晶像素的像素电压与周围的相邻液晶像素的像素电压不同。还公开了一种用于驱动液晶显示器的方法。

