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(54) LIQUID CRYSTAL DISPLAY PANEL POLARITY INVERSION DRIVING METHOD, DRIVING DEVICE AND DISPLAY DEVICE

POLARITÄTSUMKEHRUNGSANSTEUERUNGSVERFAHREN FÜR FLÜSSIGKRISTALLANZEIGETAFEL, ANSTEUERUNGSVORRICHTUNG UND ANZEIGEVORRICHTUNG

PROCÉDÉ D'ENTRAÎNEMENT D'INVERSION DE POLARITÉ DE PANNEAU D'AFFICHAGE À CRISTAUX LIQUIDES, DISPOSITIF D'ENTRAÎNEMENT ET DISPOSITIF D'AFFICHAGE

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(56) References cited:
CN-A- 1 530 723
CN-A- 1 705 006
CN-A- 102 629 453
CN-A- 103 310 756
JP-A- 2002 149 117
US-A1- 2007 070 009
US-A1- 2008 170 024
US-A1- 2008 284 706
US-A1- 2008 291 189

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Description

TECHNICAL FIELD

[0001] The present invention relates to a technical field of liquid crystal display (LCD), and particularly, to a polarity inversion driving method for a LCD panel, a driving apparatus and a display device.

BACKGROUND

[0002] Due to advantages of stable pictures, vivid images, eliminated radiation, economic space, economic power consumption and the like, Thin Film Transistor-LCDs (TFT-LCDs) are widely applied to electronic products such as televisions, mobiles, displays and the like, and are dominant in the field of tablet display.

[0003] The LCD shown in Fig. 1 basically comprises a LCD panel and a driving apparatus for the LCD panel, and the driving apparatus comprises components such as a source driver, a gate driver, a timing controller (T-con) and the like; signals transmitted to the LCD basically comprises image display signals R, G and B, enable signal DE, clock signal MCLK, and vertical synchronization signal Vsync and horizon synchronization signal Hsync. The timing controller transmits an image data signal (DATA), a row start signal (STH), a row latch signal (TP) and a polarity inversion signal (POL) to the source driver, and transmits a column start signal (STV), a column clock signal (CPV) and an output enable signal OE to the gate driver, so as to allow the LCD panel to display images.

[0004] An elementary image display unit of the LCD panel is a sub-pixel which takes on a capacitance effect in LCD panel structure, and an image will be displayed as long as a sufficient driving voltage is applied to two terminals thereof; and voltages applied to the two terminals of the capacitor are a common voltage and a data line voltage respectively. Therefore, if positive and negative polarity inversion is not performed on the voltage applied to the two terminals of the capacitor, the sub-pixels displaying the image will be charged for a long time with the same direct current voltage, and then a certain amount of charges will be deposited for a long time in a liquid crystal orientation layer and a liquid crystal layer between the common electrode and the pixel electrode, as shown in Fig.2; this will cause the sub-pixels to be undesirably displayed, the liquid crystal polarization will be resulted therefrom to the worst extent so that the liquid crystal of the sub-pixels may fail, or image sticking will occur on the LCDpanel even to a minor extent; that is, some background colors will be represented at time of display, and color contrast will be decreased too. Therefore, the signal voltages for driving the sub-pixels need the positive and negative polarity inversion at intervals, and an existing general approach is to alternatively perform polarity inversion between odd and even frames.

[0005] Even if the signal voltages with the positive and negative polarity are alternatively applied to the sub-pixels of the LCD panel, however, it is still possible that the signal voltages finally applied to the sub-pixels of the LCD panel are undesirable in terms of the positive and negative symmetry due to factors such as original positive and negative voltages provided by the driving circuit being undesirable in terns of symmetry, characteristics of the liquid crystal display panel itself being undesirable, an issue of image signal mode provided by a custom system, signal instability or the like; after the image is display for a long time, due to deflection to a certain polarity as a whole, the issues of the liquid crystal polarization or image sticking will occur generally.

[0006] US 2007/070009 A1 discloses a display device comprising: a plurality of drain electrode lines and a plurality of gate electrode lines arranged in a matrix; and pixel areas, each surrounded by two adjacent drain electrode lines and two adjacent gate electrode lines, each pixel area having a TFT element, the assembly of the pixel areas defining a display area, a drain electrode of the TFT element electrically connected to the drain electrode line, a source electrode of the TFT element electrically connected to a pixel electrode, a signal of positive polarity and a signal of negative polarity alternately applied to the pixel electrode a first frame number of times, wherein there is provided a specific period in which a signal of same polarity is applied in succession to the pixel electrode a second frame number of times that is greater than the first frame number, and in the specific period, a signal of a gray scale level lower than those in the first half and second half of the frames is applied.

[0007] US 2008/284706 A1 discloses a LCD panel comprising a matrix of pixels, which is driven with a sequence of image frames, wherein: the pixels are driven during a first frame with a first polarity pattern; the pixels with exception of a first set of pixels are driven during a second frame with an inverted polarity pattern; and the first set of pixels is driven with the inverted polarity pattern during a third frame.

[0008] US 2008/170024 A1 discloses a LCD device with a LCD panel including a plurality of data lines to which a data voltage is supplied, a plurality of gate lines to which a gate pulse is supplied, and a plurality of liquid crystal cells, a data drive circuit to invert a polarity of the data voltage in response to a polarity control signal and to output the data voltage to the data lines in response to a source output enable signal, a gate drive circuit to supply the gate pulse to the gate lines, and a POL/SOE logic circuit to invert the polarity control signal for every frame period except at Nth-multiple frame period (where N is a positive integer), wherein the POL/SOE logic circuit controls the polarity control signal at every Nth-multiple frame period such that the polarity of the data voltage is the same as the previous frame period and controls a

pulse width of the source output enable signal at every Nth-multiple frame period to be longer than for the other frame periods.

[0009] US 2008/291189 A1 discloses a LCD device includes a LCD panel having a matrix of liquid crystal cells defined by crossings of the data lines and the gate lines. The LCD device includes a data driving circuit for inverting a polarity of a data voltage in response to a polarity control signal, and supplying the polarity-inverted data voltage to an associated one of the data lines in response to a source output enable signal; a gate driving circuit for sequentially supplying a scan voltage to each of the gate lines in response to a gate output enable signal; and a controller for modulating the polarity control signal such that data voltages having the same polarity are respectively supplied to liquid crystal cells along one gate line in consecutive frame periods and generating the source output enable signal and the gate output enable signal.

SUMMARY

[0010] It is an object of the present invention to provide a polarity inversion driving method for a LCD panel to avoid such an issue that liquid crystal polarization or image sticking occurs in the liquid crystal at time of polarity inversion driving, and a polarity inversion driving apparatus for the LCD panel for implementing the driving method, and a display device comprising the polarity inversion driving apparatus for the LCD panel.

[0011] The object is achieved by the features of the respective independent claims. Further embodiments are defined in the respective dependent claims. Only the embodiment according to Figure 7 and Table 8 is an embodiment according to the present invention. All other occurrences of the word "embodiment(s)" refer to examples which were originally filed but which do not represent embodiments of the presently claimed invention; these examples are still shown for illustrative purposes only.

[0012] With polarity inversion driving method for a LCD panel according to the embodiments of the present invention, in each of the polarity
inversion driving periods, the overall polarities of the sub-pixels will not be deflected to a certain polarity, the charges are prevented from being accumulated, and such a issue that liquid crystal polarization or image sticking occurs in the liquid crystal at time of polarity inversion driving is avoided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 is a schematic diagram of a structure of a polarity inversion driving apparatus for a known liquid crystal display panel;

Fig. 2 is a schematic diagram showing influence of charges accumulated in the existing polarity inversion driving method for the liquid crystal display panel on the liquid crystal;

Fig. 3 is a schematic diagram showing a driving timing of the polarity inversion driving apparatus for the liquid crystal display panel of Fig. 1;

Fig. 4 is a schematic diagram showing polarity arrangement of frames in the existing polarity inversion driving method for the liquid crystal display panel;

Fig. 5 is a schematic diagram showing polarity arrangement of frames in a polarity inversion driving method for a liquid crystal display panel of a first embodiment of the present disclosure;

Fig. 6 is a schematic diagram showing, at time of N=1, polarity arrangement of frames in a polarity inversion driving method for a liquid crystal display panel of a second embodiment of the present disclosure;

Fig. 7 is a schematic diagram showing, at time of N=2, polarity arrangement of frames in a polarity inversion driving method for a liquid crystal display panel of a second embodiment of the present disclosure; and

Fig. 8 is a schematic diagram showing a structure of a polarity inversion driving apparatus for a liquid crystal display panel of a third embodiment of the present disclosure.

DETAILED DESCRIPTION

[0014] Hereinafter, specific implementations of the present disclosure will be further described with reference to the

appended drawings and embodiments. The following embodiments are only intended to illustrate the present disclosure, and are not to limit the present invention.

In a polarity inversion driving method for a liquid crystal display panel according to an embodiment of the present disclosure, each of frames is divided into a number of M of polarity arrangement units in a same way; it is possible that every several rows form a polarity arrangement unit, the example of which is that every row forms a polarity arrangement unit or every two rows form a polarity arrangement unit or the like, and it is also possible that a frame forms a polarity arrangement unit; every 2×M×N frames indicate an inversion driving period, in each of half inversion driving periods M×N: $\exists! x \in (0, M \times N]$, between the x-th frame and the (x+1)-th frame, except for the polarity of the first polarity arrangement unit, polarities of all the polarity arrangement units are opposite; that is, between the x-th frame and the (x+1)-th frame, only the polarities of the first arrangement units are the same, and the polarities of the second to the M-th polarity arrangement units are opposite; between any other two adjacent frames during the half inversion driving period, the polarities of the first polarity arrangement units are opposite, where ∃! represents any number in a range; $\forall m \in [0, M)$, between the (x+m × N)-th frame and the (x+m × N+1)-th frame, except for the polarity of the (m+1)-th polarity arrangement unit, polarities of all the polarity arrangement units are opposite; that is, whatever the value of m is, between the (x+m×N)-th frame and the (x+m×N+1)-th frame, the polarities of the (m+1)-th polarity arrangement units are the same, and the polarities of the first to the m-th and the (m+2)-th to the M-th polarity arrangement units are opposite; in any other two adjacent frames during the half inversion driving period, the polarities of the (m+1)-th polarity arrangement units are opposite, where ∀ represents that the numeral in the range can be applicable in sequence;

during the half inversion driving period, the polarity of each of the other frames is opposite to that of a frame adjacent thereto are opposite; wherein, each of M and N is an integer number, value of M×N is an even number, and N represents that the inversion driving of positive and negative polarity alternation in every two frames is performed once every N frames; each of x and m is an integer number; when (x+1)>M×N, (x+1) represents the first frame in the half inversion driving period; when (x+m×N)>M×N, (x+m×N) represents the (x+m×N-M×N)-th frame in the half inversion driving period; when (x+m×N+1)>M×N, (x+m×N+1) represents the (x+m×N-M×N+1)-th frame in the half inversion driving period;

in any two of the half inversion driving periods adjacent to each other, the polarities of corresponding frames are opposite.

[0015] In one of the inversion driving periods, the overall polarity of each of the polarity arrangement units will not be deflected to a certain polarity, and thus it is avoided that the liquid crystal polarization or image sticking occurs in the liquid crystal at time of polarity inversion driving.

[0016] Hereinafter, specific implementations of the embodiments of the present disclosure will be explained in conjunction with examples.

FIRST EMBODIMENT

[0017] In this embodiment, a case where each of the frames is a polarity arrangement unit and N is an even number will be illustrated.

[0018] In the existing polarity inversion driving for the liquid crystal display panel, polarity inversion of a pixel voltage signal is performed once every frame; the known polarity inversion driving apparatus for the liquid crystal display panel is as shown in Fig. 1, for the polarity inversion signal POL outputted from the timing controller, the polarity inversion signal POL_1 and polarity inversion signal_2 will be illustrated; as shown in Fig. 3, the polarity inversion signal POL_1 is a periodic signal and takes a row start signal STH as a time reference; at a timing, the polarity inversion signal POL_1 is inverted once in corresponding to each of periods the row start signal STH; the polarity inversion signal POL_2 is a periodic signal and takes the row start signal STH as a time reference; at a timing, the second polarity inversion signal POL_2 is inverted once corresponding to each two of periods of the row start signal STH; in addition, according to specification of the control signals inputted to the liquid crystal display panel, the high and low potential inversion of the polarity inversion signal should be valid only in a certain time range starting from the row start signal STH.

[0019] As shown in tables 1 and 2, under control of the polarity inversion signal POL_1, polarities of any adjacent sub-pixels are opposite to each other and the polarities of any two frames adjacent to each other are opposite to each other; in this embodiment, the polarity is a polarity with respect to the voltage of a common electrode; in the tables 1 and 2, a symbol of "+" indicates a positive voltage with respect to the voltage of the common electrode, and the symbol of "-" indicates a negative voltage with respect to the voltage of the common electrode.

Table 1 polarity arrangement of odd frames in existing polarity inversion driving method

	first column	second column	third column	fourth column	fifth column	···	n-th column
first row	+	-	+	-	+	···	-
second row	-	+	-	+	-	···	+

(continued)

	first column	second column	third column	fourth column	fifth column	···	n-th column
third row	+	-	+	-	+	···	-
fourth row	-	+	-	+	-	···	+
fifth row	+	-	+	-	+	···	-
sixth row	-	+	-	+	-	···	+
seventh row	+	-	+	-	+	···	-
...	...	...	...	...	...	...	...
eighth row	-	+	-	+	-	···	+

Table 2 polarity arrangement of even frames in existing polarity inversion driving method

	first column	second column	third column	fourth column	fifth column	···	n-th column
first row	-	+	-	+	-	···	+
second row	+	-	+	-	+	···	-
third row	-	+	-	+	-	···	+
fourth row	+	-	+	-	+	···	-
fifth row	-	+	-	+	-	···	+
sixth row	+	-	+	-	+	···	-
seventh row	-	+	-	+	-	···	+
...	...	...	...	...	...	...	...
eighth row	+	-	+	-	+	···	-

[0020] Due to factors such as original positive and negative voltages provided by the driving circuit being undesirable in terns of symmetry, characteristics of the liquid crystal display panel itself being undesirable, a issue of image signal mode provided by a custom system, signal instability or the like, it is possible that the signal voltages finally applied to the sub-pixels of the liquid crystal display panel are undesirable in terms of the positive and negative symmetry; for example, as shown in table 3, the overall polarity thereof is negative. In this way, after an image is displayed for a long time, the pixel voltage signal of each of sub-pixels is deflected to a certain polarity as a whole. For a single sub-pixel shown in Fig. 4 (sub-pixel shown in the drawing with background filled is exemplified), the overall voltage change in the single sub-pixel is shown in table 4; it can be seen that, the overall polarity of the single sub-pixel is negative, and thus, the issues of liquid crystal polarization or image sticking will occur.

Table 3 table of polarities of frames in the existing polarity inversion driving method

row	frame sequence number														
	1	2	···	N-1	N	N+1	N+2	···	2N-1	2N	2N+1	2N+2	···	3N-1	3N
1	L	H	···	L	H	L	H	···	L	H	L	H	···	L	H
2	H	L	···	H	L	H	L	···	H	L	H	L	···	H	L
3	L	H	···	L	H	L	H	···	L	H	L	H	···	L	H
4	H	L	···	H	L	H	L	···	H	L	H	L	···	H	L
5	L	H	···	L	H	L	H	···	L	H	L	H	···	L	H
6	H	L	···	H	L	H	L	···	H	L	H	L	···	H	L
7	L	H	···	L	H	L	H	···	L	H	L	H	···	L	H
8	H	L	···	H	L	H	L	···	H	L	H	L	···	H	L

(continued)

row	frame sequence number														
	1	2	···	N-1	N	N+1	N+2	···	2N-1	2N	2N+1	2N+2	···	3N-1	3N
Total	overall polarity is negative					overall polarity is negative					overall polarity is negative				

Table 4 voltage changes in a single sub-pixel shown in Fig. 4

	first frame	second frame	third frame	fourth frame	fifth frame	sixth frame	seventh frame	eighth frame
grey level	0	128	0	128	0	128	0	128
voltage	+0V	-4V	+0V	-4V	+0V	-4V	+0V	-4V
average voltage	-2V		-2V		-2V		-2V	
defect	a voltage of -2VDC is applied for a long time, and liquid crystal polarization or image sticking occurs.							

[0021] On the basis of the driving method in which the positive and negative polarities are alternatively inverted per frame as described above, in the polarity inversion driving method for the liquid crystal display panel according to the embodiments of the present disclosure, every N frames, the inversion driving of positive and negative polarities alternation in two frames is performed once (referred to as two-frame inversion hereinafter), as shown in Fig. 5; in this way, polarity inversion driving period is 2N frame; in each of half inversion driving periods, only one set of two frames adjacent to each other are the same in terms of polarity, and in the half inversion driving period, the other sets of two frames adjacent to each other are opposite in terms of polarity; in any two of the half inversion driving periods adjacent to each other, the corresponding frames are opposite in terms of polarity.

Table 5 Polarity table of the frames in the polarity inversion driving method of the present embodiment

row	frame sequence number														
	1	2	···	N-1	N	N+1	N+2	···	2N-1	2N	2N+1	2N+2	···	3N-1	3 N
1	L	H	···	L	H	H	L	···	H	L	L	H	···	L	H
2	H	L	···	H	L	L	H	···	L	H	H	L	···	H	L
3	L	H	···	L	H	H	L	···	H	L	L	H	···	L	H
4	H	L	···	H	L	L	H	···	L	H	H	L	···	H	L
5	L	H	···	L	H	H	L	···	H	L	L	H	···	L	H
6	H	L	···	H	L	L	H	···	L	H	H	L	···	H	L
7	L	H	···	L	H	H	L	···	H	L	L	H	···	L	H
8	H	L	···	H	L	L	H	···	L	H	H	L	···	H	L
Total	overall polarity is negative					overall polarity is positive					overall polarity is negative				

[0022] As can be apparently seen from Fig. 5, the overall polarity of each of the frames is alternated in the positive and negative. In this way, in displaying an image for long time, since the overall polarity of the pixel voltage signal of each of the sub-pixels is alternated in the positive and negative, the average voltage is equal to zero, and will not deflected to a certain polarity.

[0023] As shown in Fig. 5, when N=4, the two-frame inversion is performed once every four frames; for the single sub-pixel shown in Fig. 5 (sub-pixel shown in the drawing with background filled is exemplified), the overall voltage changes in the single sub-pixel is shown in table 6; it can be seen that, the overall average voltage of the single sub-pixel is equal to zero, and the polarity will not be deflected to a certain polarity, which prevents the charges from accumulating, and thus it is avoid that liquid crystal polarization or image sticking occurs in the liquid crystal at time of polarity inversion driving.

Table 6 voltage changes in the single sub-pixel shown in Fig. 5

	first frame	second frame	third frame	fourth frame	fifth frame	sixth frame	seventh frame	eighth frame
grey level	128	0	128	0	128	0	128	0
voltage	-4V	-0V	+4V	-0V	+4V	+0V	-4V	+0V
average voltage	-2V		+2V		+2V		-2V	
defect	voltages of -2V and +2VDC are alternatively applied, the overall average voltage is equal to zero, and liquid crystal polarization or image sticking will not occur							

[0024] In order to reduce impact of interference phenomenon of chroma and brightness in a frame, in the present embodiment, polarities of any two adjacent sub-pixels in each of the frames are opposite. Of course, other implementations are also possible; for example, three sub-pixels of RGB serve as a pixel unit, and polarities of any two adjacent pixel units in each of the frames are opposite, and the like.

SECOND EMBODIMENT

[0025] The polarity inversion driving method for the liquid crystal display panel of the first embodiment is easy to be implemented and operated, however, since when the two-frame inversion is performed every N frames, the change in polarity of the full picture is not consistent with that of the other frames, and thus light and dark changes are generated, which is visually presented as a flicker phenomenon. In order to solve this issue, in this embodiment, each of the rows is a polarity arrangement unit; every N frames, the two-frame inversion is performed once on this row, and the two-frame inversion is performed alternatively on the respective rows, so that it is avoided that the full picture is changed simultaneously. For example, Fig. 7 shows polarity changes in respective rows in each of the frames with N=1. Polarity arrangement of the frames is as shown in Fig. 6; as can be seen from table 7 and Fig. 6 that, with respect to the first row, the two-frame inversion is performed at the second frame; with respect to the second row, the two-frame inversion is performed at the third frame; with respect to the third row, the two-frame inversion is performed at the fourth frame; with respect to the fourth row, the two-frame inversion is performed at the fifth frame, and the like. For another example, when N is equal to 4, it is possible that, with respect to the first row, the two-frame inversion is performed at the fourth frame; with respect to the second row, the two-frame inversion is performed at the eighth frame; with respect to the third row, the two-frame inversion is performed at the twelfth frame; with respect to the fourth row, the two-frame inversion is performed at the sixteenth frame, and the like. For another example, Fig. 8 shows polarity change in respective rows in each of the frames with N=2; polarity arrangement of the frames is as shown in Fig. 7; as can be seen from table 8 and Fig. 7 that, with respect to the first row, the two-frame inversion is performed at the second frame; with respect to the second row, the two-frame inversion is performed at the fourth frame; with respect to the third row, the two-frame inversion is performed at the sixth frame; with respect to the fourth row, the two-frame inversion is performed at the eighth frame, and the like. For another example, when N is equal to 4, it is possible that, with respect to the first row, the two-frame inversion is performed at the fourth frame; with respect to the second row, the two-frame inversion is performed at the eighth frame; with respect to the third row, the two-frame inversion is performed at the twelfth frame; with respect to the fourth row, the two-frame inversion is performed at the sixteenth frame, and the like.

Table 7 Polarity table of the frames in the polarity inversion driving method of the present embodiment with N=1

row	frame sequence number																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	H	H	L	H	L	H	L	H	L	L	H	L	H	L	H	L	H	H
2	L	H	H	L	H	L	H	L	H	L	L	H	L	H	L	H	L	H
3	H	L	H	H	L	H	L	H	L	H	L	L	H	L	H	L	H	L
4	L	H	L	H	H	L	H	L	H	L	H	L	L	H	L	H	L	H
5	H	L	H	L	H	H	L	H	L	H	L	H	L	L	H	L	H	L

(continued)

row	frame sequence number																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
6	L	H	L	H	L	H	H	L	H	L	H	L	H	L	L	H	L	H
7	H	L	H	L	H	L	H	H	L	H	L	H	L	H	L	L	H	L
8	L	H	L	H	L	H	L	H	H	L	H	L	H	L	H	L	L	H

Table 8 Polarity table of the frames in the polarity inversion driving method of the present embodiment with N=2

row	frame number																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	H	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	L
2	L	H	L	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L
3	H	L	H	L	H	H	L	H	L	H	L	H	L	H	L	H	L	H
4	L	H	L	H	L	H	L	L	H	L	H	L	H	L	H	L	H	L
5	H	L	H	L	H	L	H	L	H	H	L	H	L	H	L	H	L	H
6	L	H	L	H	L	H	L	H	L	H	L	L	H	L	H	L	H	L
7	H	L	H	L	H	L	H	L	H	L	H	L	H	H	L	H	L	H
8	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	L	H	L

[0026] In the present embodiment, in the x-th frame (first frame) as the start frame of each of half inversion driving periods, polarities of any two rows adjacent to each other are opposite, and polarities of two adjacent sub-pixels on each of the rows are opposite; all of these are to reduce the impact of interference phenomenon of chroma and brightness in a frame. Of course, for practical application, it is also possible to adjust the polarity arrangement of the respective polarity arrangement units and adjust the division of the respective polarity arrangement units as necessary, and is not limited to the polarity arrangement and division form of the polarity arrangement units exemplified in the present embodiment.

THIRD EMBODIMENT

[0027] Embodiments of the present disclosure also provide a driving apparatus for implementing any one of the above polarity inversion driving methods for the liquid crystal display panel; as shown in Fig. 8, the polarity inversion driving apparatus for the liquid crystal display panel comprises components such as a timing controller, an calculator, a source driver, a gate driver and the like; signals transmitted by a custom system to the liquid crystal display basically comprises image display signals R, G and B, enable signal DE, clock signal MCLK, vertical synchronization signal Vsync and horizon synchronization signal Hsync and control signal of the calculator Cs; the timing controller transmits an image data signal (DATA), a row start signal (STH) and a row latch signal (TP) to the source driver, and transmits a column start signal (STV), a column clock signal (CPV) and an output enable signal OE to the gate driver, so as to allow the liquid crystal display panel to display images; the timing controller outputs M first polarity inversion signals corresponding to each of the polarity arrangement units respectively to the calculator, and the first polarity inversion signal and the control signal Cs are subjected to the logic operation in the calculator to form a second polarity inversion signal and inputted to the source driver; the first polarity inversion signal of each of the frames is the second polarity inversion signal of the previous frame; in each of the half inversion driving periods, the second polarity inversion signal in the (x+1)th frame corresponding to the first polarity arrangement unit is an in-phase signal of the second polarity inversion signal in the x-th frame corresponding to the first polarity arrangement unit, and the second polarity inversion signal in the other frames corresponding to the first polarity arrangement unit is an out-phase signal of the second polarity inversion signal in the previous frame corresponding to the first polarity arrangement unit; the second polarity inversion signal in the (x+m×N+1)-th frame corresponding to the (m+1)-th polarity arrangement unit is an in-phase signal of the second polarity inversion signal in the (x+m×N)-th frame corresponding to the (m+1)-th polarity arrangement unit, and the second polarity inversion signal in the other frames corresponding to the (m+1)-th polarity arrangement unit is an out-phase signal of the second polarity inversion signal in the previous frame corresponding to the (m+1)-th polarity arrangement unit. In

this way, the two-frame inversion being performed once on a polarity arrangement unit is realized every N frames, so that in each of the polarity inversion driving periods, the overall polarities of the sub-pixels will not be deflected to a certain polarity, which prevents the charges from accumulating, and thus it is avoided that liquid crystal polarization or image sticking occurs in the liquid crystal at time of polarity inversion driving. The first polarity inversion signal POL can be the polarity inversion signal POL_1 or polarity inversion signal POL_2 described in the first embodiment, or the like, and the logic operation that the first polarity inversion signal and the control signal C2 are subjected to in the calculator can be implemented in several ways; for example, the second polarity inversion signal corresponding to the first polarity arrangement unit is the POL1, the control signal Cs1 corresponding to the second polarity inversion signal is a high level signal in the x-th frame, and is at the low level in other frames; the second polarity inversion signal in each of the frames corresponding to first polarity arrangement unit and the control signal are subjected to a logic operation of $\overline{POL_1}\times\overline{Cs_1}+POL_1\times Cs_1$ in the calculator to generate a corresponding second polarity inversion signal in the next frame; the second polarity inversion signal corresponding the (m+1)-th polarity arrangement unit is the POL_{m+1}; the control signal Cs_{m+1} corresponding to the second polarity inversion signal is the high level signal in the (x+m×N)-th frame, and is at low level in the other frames; the second polarity inversion signal in each of the frames corresponding to the (m+1)-th polarity arrangement unit and the control signal are subjected to a logic operation of $\overline{POL_m}\times\overline{Cs_m}+POL_m\times Cs_m$ in the calculator to generate a corresponding second polarity inversion signal in the next frame; for another example, the second polarity inversion signal corresponding to the (m+1)-th polarity arrangement unit is the POL_{m+1}, the control signal Cs_{m+1} corresponding to the second polarity inversion signal is the low level in the (x+m×N)-th frame, and is at high level in the other frames; the second polarity inversion signal in each of the frames corresponding to first polarity arrangement unit and the control signal are subjected to a logic operation of $\overline{POL_1}\times Cs_1+POL_1\times\overline{Cs_1}$ in the calculator to generate a corresponding second polarity inversion signal in a next frame; the second polarity inversion signal corresponding to the (m+1)-th polarity arrangement unit is the POL_{m+1}, the control signal Cs_{m+1} corresponding to the second polarity inversion signal is the low level in the (x+m×N)-th frame, and is at high level in other frames; the second polarity inversion signal in each of the frames corresponding to the (m+1)-th polarity arrangement unit and the control signal are subjected to a logic operation of $\overline{POL_m}\times Cs_m+POL_m\times\overline{Cs_m}$ in the calculator to generate a corresponding second polarity inversion signal in a next frame.

[0028] An embodiment of the present disclosure further provides a display device comprising the above polarity inversion driving apparatus for the liquid crystal display panel; since the adopted polarity inversion driving apparatus addresses such a issue that liquid crystal polarization or image sticking occurs in the liquid crystal at time of polarity inversion driving, this display device enjoys a relatively high reliability, and can optimize and improve user's experience to some extent. The display device can be any of products or means with display function, such as liquid crystal display panel, electronic paper, liquid crystal TV, liquid crystal display, organic electroluminescence display, digital photo frame, mobile, tablet computer or the like.

Claims

1. A polarity inversion driving method of a liquid crystal display, LCD, panel, wherein each of the frames is divided into M polarity arrangement units in a same manner, every 2xMxN frames form an inversion driving period, wherein N=2, the driving method comprising:

   applying driving signals to the pixels of the M polarity arrangement units in a first and $(2M+1)^{th}$ frame, such that two adjacent polarity arrangement units have pixels in same columns with opposite polarities, and corresponding pixels in the first and $(2M+1)^{th}$ frames have opposite polarities,

   $\forall\ m \in [1, M]$, applying driving signals such that, in the m^{th} polarity arrangement unit, pixels of the $(2m-1)^{th}$ frame have a same polarity as corresponding pixels of the $(2m)^{th}$ frame, and, in all polarity arrangement units except in the m^{th} polarity arrangement unit, pixels of the $(2m-1)^{th}$ frame have opposite polarities to the polarities of corresponding pixels of the $(2m)^{th}$ frame,

   $\forall\ m \in [M+1, 2M]$, applying driving signals such that, in the $(m-M)^{th}$ polarity arrangement unit, pixels of the $(2m-1)^{th}$ frame have a same polarity as corresponding pixels of the $(2m)^{th}$ frame, and, in all polarity arrangement units except in the $(m-M)^{th}$ polarity arrangement unit, pixels of the $(2m-1)^{th}$ frame have opposite polarities to the polarities of corresponding pixels of the $(2m)^{th}$ frame,

   $\forall\ m \in [1, 2M)$, applying driving signals such that, in the M polarity arrangement units, pixels in the $(2m)^{th}$ frame have opposite polarities to the polarities of corresponding pixels in the $(2m+1)^{th}$ frame, wherein the polarity arrangement unit is a row and each two adjacent pixels in each row have opposite polarities.

2. The polarity inversion driving method for the LCD panel according to claim 1, wherein the polarity is a polarity with respect to a common electrode voltage.

3. An apparatus configured for implementing the polarity inversion driving method for the LCD panel according to any one of claims 1-2, comprising a timing controller, a source driver and a calculator, wherein the timing controller is configured to output M first polarity inversion signals corresponding to each of the polarity arrangement units to the calculator, and the M first polarity inversion signals and the control signal are subjected to a logic operation in the calculator to form M second polarity inversion signals to be inputted to the source driver;
the first polarity inversion signal of the $(m+1)^{th}$ frame is the second polarity inversion signal in the m^{th} frame; $\forall$ m $\in$ [1, 2M], the second polarity inversion signal in the $(2m-1)^{th}$ frame corresponding to the $(m)^{th}$ polarity arrangement unit is in phase with a corresponding second polarity inversion signal in the $(2m)^{th}$ frame, and the second polarity inversion signals in the $(2m-1)^{th}$ frame corresponding to all polarity arrangement units except the m^{th} polarity arrangement unit are out of phase with corresponding second polarity inversion signals in the $(2m)^{th}$ frame.

4. The apparatus according to claim 3, wherein the second polarity inversion signal corresponding to the $(m)^{th}$ polarity arrangement unit is POL_m, the control signal Cs_m corresponding to the second polarity inversion signal is at a high level in the $(2m-1)^{\underline{th}}$ frame, and is at a low level in other frames; the second polarity inversion signal in each of the frames corresponding to the $(m)^{th}$ polarity arrangement unit and the control signal are subjected to a logic operation of $\overline{POL_m} \times \overline{Cs_m} + POL_m \times Cs_m$ in the calculator to generate a corresponding second polarity inversion signal in a $(2m)^{th}$ frame.

5. The apparatus according to claim 3, wherein the second polarity inversion signal corresponding to the $(m)^{th}$ polarity arrangement unit is POL_m, the control signal Cs_m corresponding to the second polarity inversion signal is at a low level in the $(2m-1)^{th}$ frame, and is at a high level in other frames; the second polarity inversion signal in each of the frames corresponding to the $(m)^{th}$ polarity arrangement unit and the control signal are subjected to a logic operation of $\overline{POL_m} \times Cs_m + POL_m \times \overline{Cs_m}$ in the calculator to generate a corresponding second polarity inversion signal in a $(2m)^{th}$ frame.

6. A display device, comprising the apparatus according to any one of claims 3-5.

Patentansprüche

1. Polaritätsinversion-Steuerverfahren eines Flüssigkristallanzeige-, LCT-, Panels, wobei jeder der Rahmen in M Polaritätsanordnungseinheiten in gleicher Weise unterteilt ist, wobei alle 2xMxN Rahmen eine Inversionssteuerperiode bilden, wobei N=2 gilt, wobei das Steuerverfahren aufweist:

   Anlegen von Steuersignalen an die Pixel der M Polaritätsanordnungseinheiten in einem ersten und einem (2M+1)-ten Rahmen derart, dass zwei benachbarte Polaritätsanordnungseinheiten in einer gleichen Spalte Pixel mit umgekehrten Polaritäten aufweisen, und entsprechende Pixel in dem ersten und (2M+1)-ten Rahmen entgegengesetzte Polaritäten aufweisen,
   $\forall$ m$\in$[1, M], Anlegen von Steuersignalen derart, dass in der m-ten Polaritätsanordnungseinheit Pixel des (2m-1)-ten Rahmens eine gleiche Polarität aufweisen wie entsprechende Pixel des (2m)-ten Rahmens und in allen Polaritätsanordnungseinheiten ausgenommen in der m-ten Polaritätsanordnungseinheit Pixel des (2m-1)-ten Rahmen entgegengesetzte Polaritäten zu den Polaritäten der entsprechender Pixel des (2m)-ten Rahmen aufweisen,
   $\forall$ m$\in$[M+1, 2M], Anlegen von Steuersignalen derart, dass in der (m-M)-ten Polaritätsanordnungseinheit Pixel des (2m-1)-ten Rahmens eine gleiche Polarität aufweisen wie entsprechende Pixel des (2m)-ten Rahmens und in allen Polaritätsanordnungseinheiten ausgenommen in der (m-M)-ten Polaritätsanordnungseinheit Pixel des (2n-1)-ten Rahmens entgegengesetzte Polaritäten zu den Polaritäten entsprechender Pixel des (2m)-ten Rahmens aufweisen,
   $\forall$ m$\in$[1,2M], Anlegen von Steuersignalen derart, dass in der M Polaritätsanordungseinheit Pixel in dem (2m)-ten Rahmen entgegengesetzte Polaritäten zu den Polaritäten der entsprechenden Pixel in dem (2m+1)-ten Rahmen aufweisen, wobei die Polaritätsanordnungseinheit eine Reihe ist und alle zwei benachbarten Pixel in jeder Reihe entgegengesetzte Polaritäten aufweisen.

2. Polaritätsinversionsansteuerverfahren für das LCD-Panel gemäß Anspruch 1, wobei die Polarität eine Polarität mit Bezug auf eine gemeinsame Elektrodenspannung ist.

3. Vorrichtung konfiguriert zum Umsetzen des Polaritätsinversion-Steuerverfahrens für das LCD-Panel gemäß einem der Ansprüche 1 bis 2, aufweisend eine Zeitablaufsteuerung, eine Source-Ansteuereinrichtung und eine Recheneinrichtung, wobei die Zeitablaufsteuerungseinrichtung konfiguriert ist, M erste Polaritätsinversionssignale entsprechend jeder der Polaritätsanordnungseinheiten an die Berechnungseinheit auszugeben, und die M ersten Polaritätsinversionssignale und das Steuersignal einer Logikoperation in der Recheneinrichtung unterworfen werden, um M zweite Polaritätsinversionssignale zu bilden, die an die Source-Ansteuereinrichtung auszugeben sind;
das erste Polaritätsinversionssignal des (m+1)-ten Rahmens das zweite Polaritätsinversionssignal in dem m-ten Rahmen ist;
$\forall$ m$\in$[1, 2M], das zweite Polaritätsinversionssignal in dem (2m-1)-ten Rahmen entsprechend der (m)-ten Polaritätsanordnungseinheit in Phase mit einem entsprechenden zweiten Polaritätsinversionssignal in dem (2m)-ten Rahmen ist, und die zweiten Polaritätsinversionssignale in dem (2m-1)-ten Rahmen entsprechend allen Polaritätsanordnungseinheiten ausgenommen der m-ten Polaritätsansteuereinheit außer Phase mit entsprechenden zweiten Polaritätsinversionssignalen in dem (2m)-ten Rahmen sind.

4. Vorrichtung gemäß Anspruch 3, wobei das zweite Polaritätsinversionssignal entsprechend der (m)-ten Polaritätsanordnungseinheit ein POL_m ist, das Steuersignal Cs_m entsprechend dem zweiten Polaritätsinversionssignal ein Hoch-Pegel in dem (2m-1)-ten Rahmen ist, und ein Niedrig-Pegel in anderen Rahmen ist; das zweite Polaritätsinversionssignal in jedem der Rahmen entsprechend der (m)-ten Polaritätsanordnungseinheit und das Steuersignal einer Logikoperation gemäß $\overline{POL_m}x\overline{Cs_m} + POL_m x CS_m$ in der Recheneinheit unterworfen werden, um ein entsprechendes zweites Polaritätsinversionssignal in einem (2m)-ten Rahmen zu erzeugen.

5. Vorrichtung gemäß Anspruch 3, wobei das zweite Polaritätsinversionssignal entsprechend der (m)-ten Polaritätsanordnungseinheit ist POL_m, das Steuersignal Cs_m entsprechend dem zweiten Polaritätsinversionssignal ein Niedrig-Pegel in dem (2m-1)-ten Rahmen ist, und ein Hoch-Pegel in anderen Rahmen ist; das zweite Polaritätsinversionssignal in jedem der Rahmen entsprechend der (m)-ten Polaritätsanordnungseinheit und dem Steuersignal einer Logikoperation gemäß $\overline{POL_m}xCs_m + POL_m x\overline{CS_m}$ in der Recheneinheit unterworfen werden, um ein entsprechendes zweites Polaritätsinversionssignal in einem (2m)-ten Rahmen zu erzeugen.

6. Anzeigevorrichtung mit der Vorrichtung gemäß einem der Ansprüche 3 bis 5.

Revendications

1. Procédé de commande d'inversion de polarité d'un panneau d'affichage à cristaux liquide (LCD, Liquid Crystal Display), dans lequel chacune des trames est divisée en M unités d'agencement de polarité de la même manière, des trames toutes les 2xMxN trames formant une période de commande d'inversion, où N = 2, le procédé de commande comprenant les étapes consistant à :

appliquer des signaux de commande aux pixels des M unités d'agencement de polarité dans des première et $(2M+1)^{ième}$ trames, de telle sorte que deux unités d'agencement de polarité adjacentes présentent des pixels dans les mêmes colonnes avec des polarités opposées, et des pixels correspondants dans les première et $(2M+1)^{ième}$ trames présentent des polarités opposées ;
$\forall$ m $\in$ [1, M], appliquer des signaux de commande de telle sorte que dans la $m^{ième}$ unité d'agencement de polarité, des pixels de la $(2m-1)^{ième}$ trame présentent la même polarité que des pixels correspondants de la $(2m)^{ième}$ trame, et dans toutes les unités d'agencement de polarité excepté dans la $m^{ième}$ unité d'agencement de polarité, des pixels de la $(2m-1)^{ième}$ trame présentent des polarités opposées aux polarités de pixels correspondants de la $(2m)^{ième}$ trame ;
$\forall$ m $\in$ [M+1, 2M], appliquer des signaux de commande de telle sorte que dans la $(m-M)^{ième}$ unité d'agencement de polarité, des pixels de la $(2m-1)^{ième}$ trame présentent une même polarité que des pixels correspondants de la $(2m)^{ième}$ trame, et dans toutes les unités d'agencement de polarité excepté dans la $(m-M)^{ième}$ unité d'agencement de polarité, des pixels de la $(2m-1)^{ième}$ trame présentent des polarités opposées aux polarités de pixels correspondants de la $(2m)^{ième}$ trame, et
$\forall$ m $\in$ [1, 2M), appliquer des signaux de commande de telle sorte que dans les M unités d'agencement de polarité, des pixels dans la $(2m)^{ième}$ trame présentent des polarités opposées aux polarités de pixels corres-

pondants de la (2m+1)ième trame, dans lequel l'unité d'agencement de polarité est une rangée, et deux pixels adjacents dans chaque rangée présentent à chaque fois des polarités opposées.

2. Procédé de commande d'inversion de polarité pour le panneau LCD selon la revendication 1, dans lequel la polarité est une polarité par rapport à une tension d'électrode de référence.

3. Appareil configuré pour mettre en oeuvre le procédé de commande d'inversion de polarité pour le panneau LCD selon l'une quelconque des revendications 1 à 2, comprenant un contrôleur de temporisation, un circuit d'attaque de source et un calculateur, dans lequel le contrôleur de temporisation est configuré pour produire M premiers signaux d'inversion de polarité correspondant à chacune des unités d'agencement de polarité vers le calculateur, et les M premiers signaux d'inversion de polarité et le signal de commande sont soumis à une opération logique dans le calculateur afin de former M seconds signaux d'inversion de polarité à entrer dans le circuit d'attaque de source ;
le premier signal d'inversion de polarité de la (m+1)ième trame est le second signal d'inversion de polarité dans la mième trame, et
$\forall$ m $\in$ [1, 2M], le second signal d'inversion de polarité dans la (2m-1)ième trame correspondant à la (m)ième unité d'agencement de polarité est en phase avec un second signal d'inversion de polarité dans la (2m)ième trame, et les seconds signaux d'inversion de polarité dans la (2m-1)ième trame correspondant à toutes les unités d'agencement de polarité excepté la mième unité d'agencement de polarité sont déphasés par rapport aux seconds signaux d'inversion de polarité correspondants dans la (2m)ième trame.

4. Appareil selon la revendication 3,
dans lequel le second signal d'inversion de polarité correspondant à la (m)ième unité d'agencement de polarité est POL_m; le signal de commande Cs_m correspondant au second signal d'inversion de polarité est sur un niveau haut dans la (2m-1)ième trame, et est sur un niveau bas dans d'autres trames ; le second signal d'inversion de polarité dans chacune des trames correspondant à la (m)ième unité d'agencement de polarité et le signal de commande sont soumis à une opération logique $\overline{POL_m}x\text{-}\overline{Cs_m} + POL_m x CS_m$ dans le calculateur afin de générer un second signal d'inversion de polarité correspondant dans une (2m)ième trame.

5. Appareil selon la revendication 3,
dans lequel le second signal d'inversion de polarité correspondant à la (m)ième unité d'agencement de polarité est POL_m; le signal de commande Cs_m correspondant au second signal d'inversion de polarité est sur un niveau bas dans la (2m-1)ième trame, et est sur un niveau haut dans d'autres trames ; le second signal d'inversion de polarité dans chacune des trames correspondant à la (m)ième unité d'agencement de polarité et le signal de commande sont soumis à une opération logique

$$\overline{POL_m} \times Cs_m + POL_m \times \overline{Cs_m}$$

dans le calculateur afin de générer un second signal d'inversion de polarité correspondant dans une (2m)ième trame.

6. Dispositif d'affichage, comprenant l'appareil selon l'une quelconque des revendications 3 à 5.

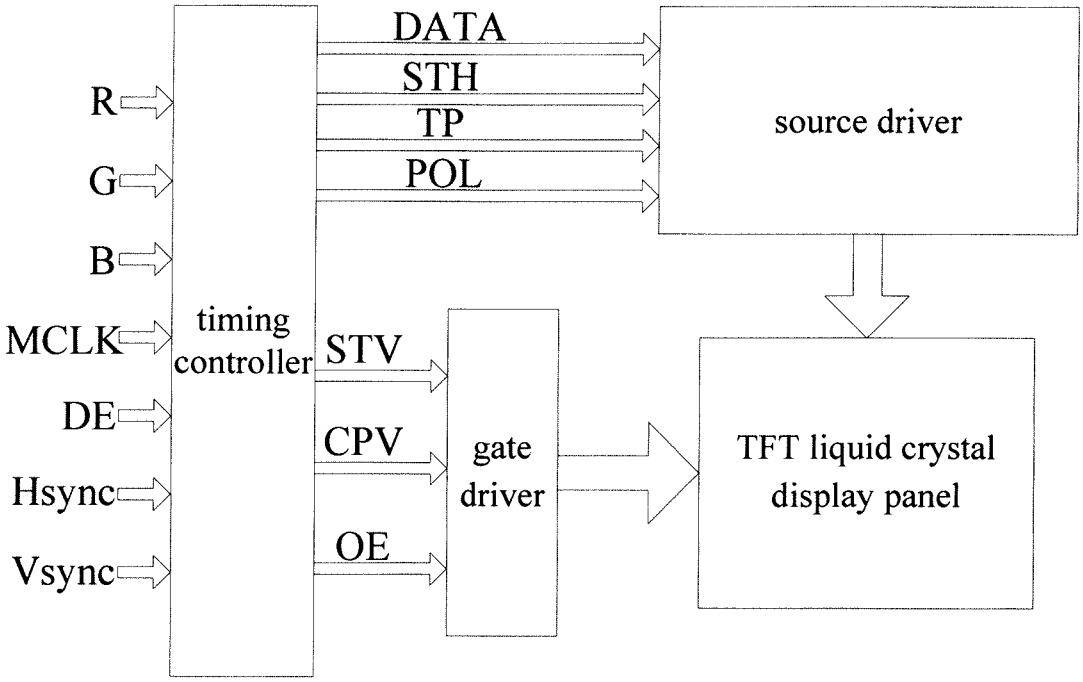
R
G
B
MCLK
DE
Hsync
Vsync
timing controller
DATA
STH
TP
POL
STV
CPV
OE
gate driver
source driver
TFT liquid crystal display panel

Fig.1

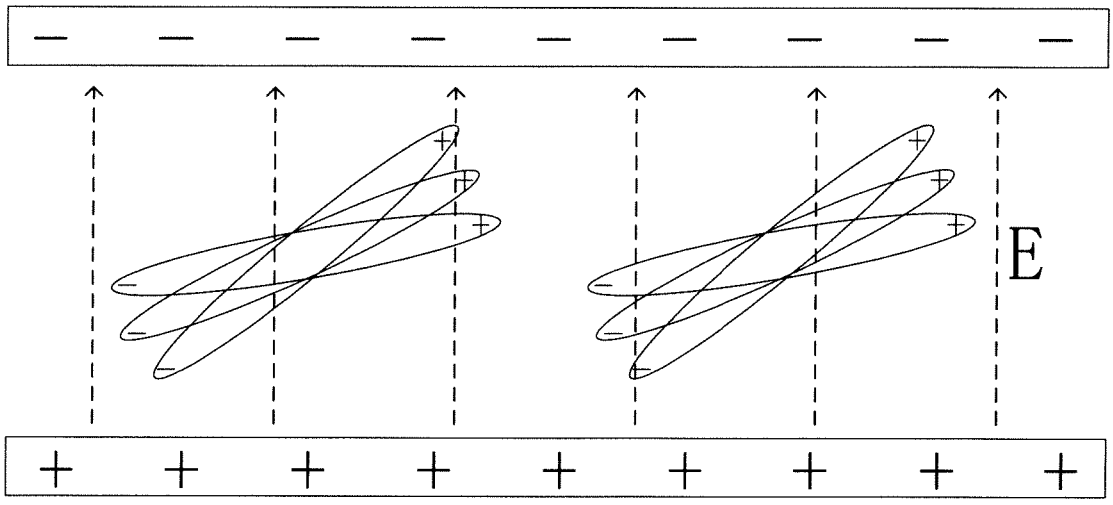
E

Fig.2

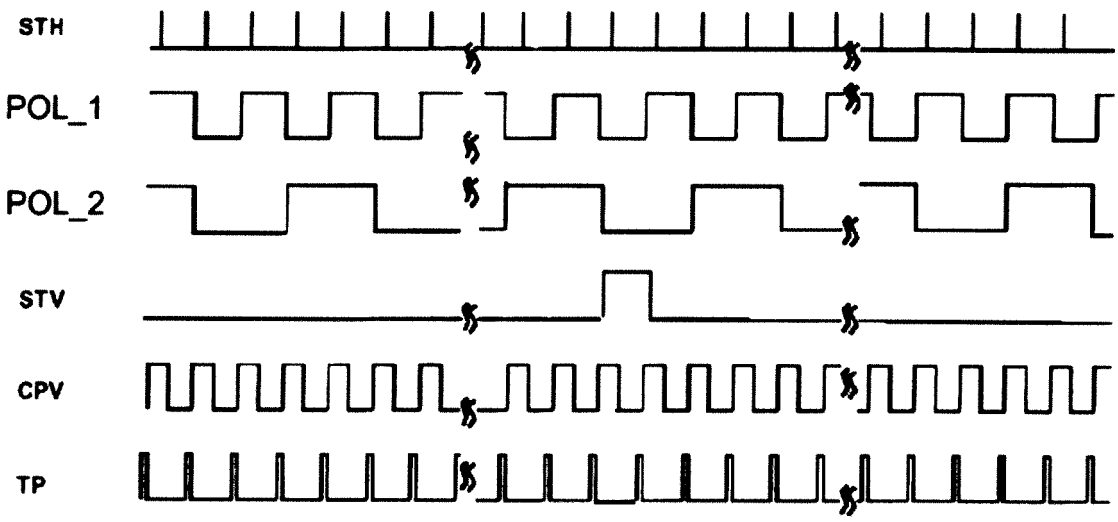

Fig.3

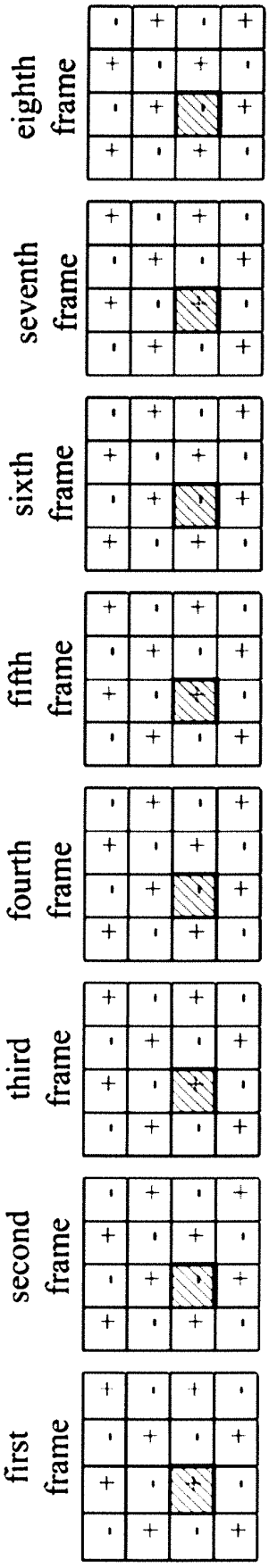
first frame
second frame
third frame
fourth frame
fifth frame
sixth frame
seventh frame
eighth frame

Fig.4

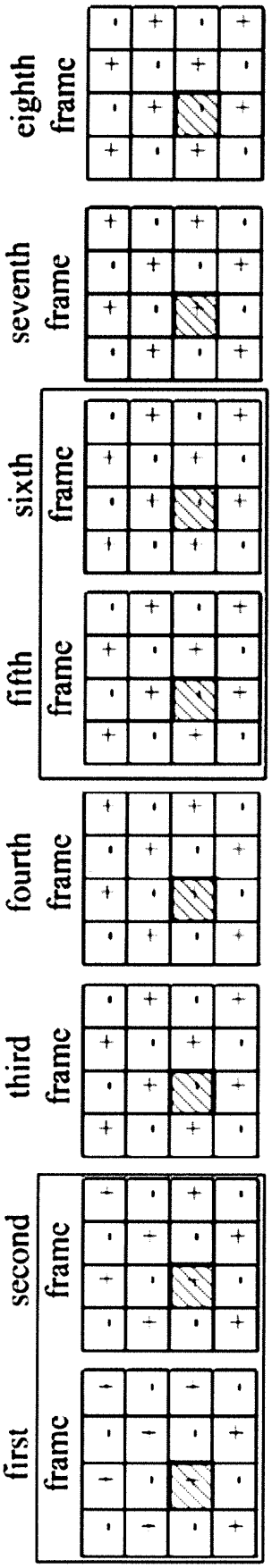
first frame
second frame
third frame
fourth frame
fifth frame
sixth frame
seventh frame
eighth frame

Fig.5

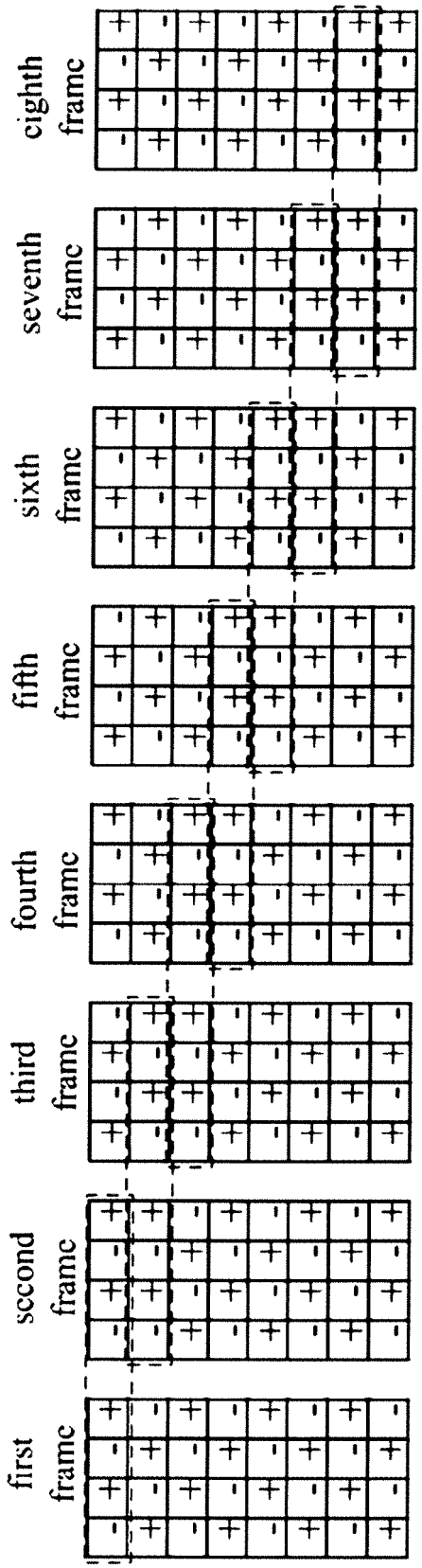
first frame
second frame
third frame
fourth frame
fifth frame
sixth frame
seventh frame
eighth frame

Fig.6

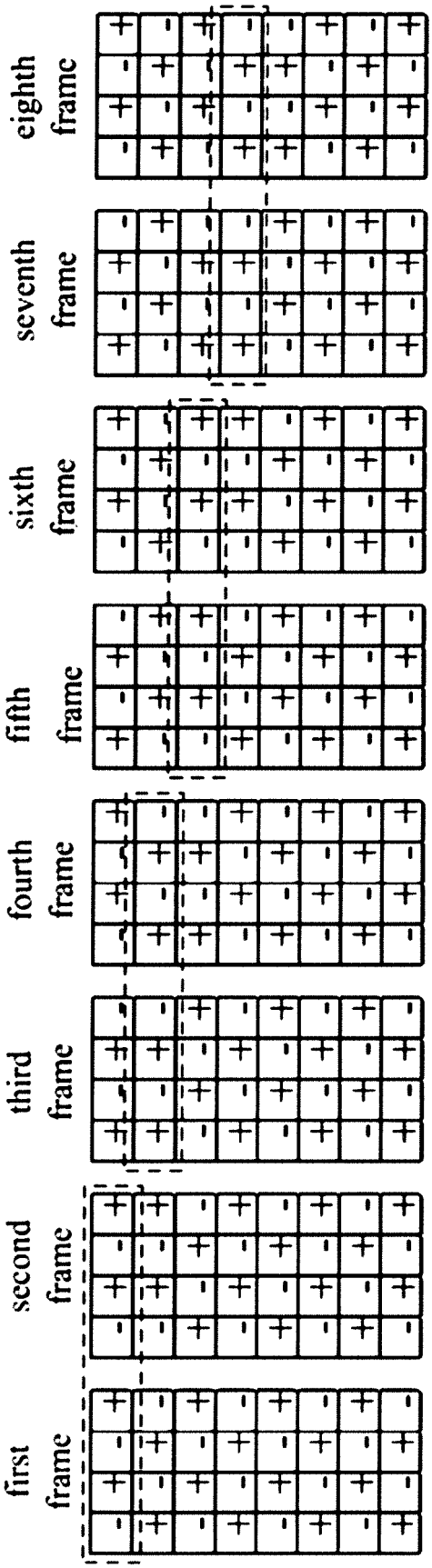
first frame
second frame
third frame
fourth frame
fifth frame
sixth frame
seventh frame
eighth frame

Fig.7

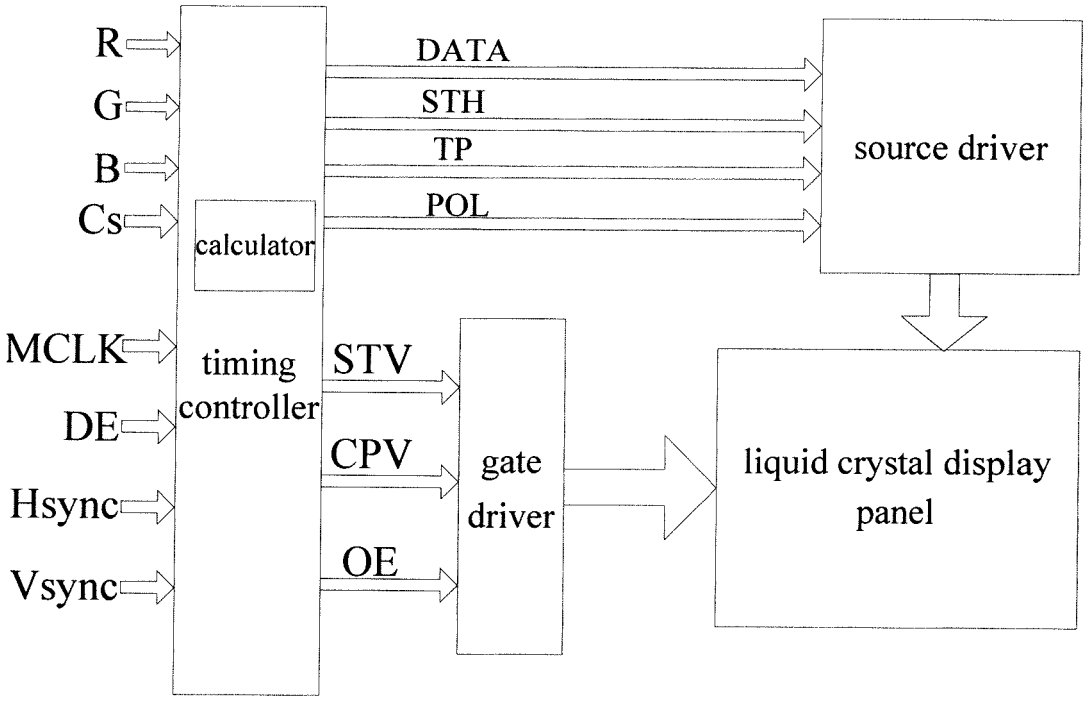
R
G
B
Cs
calculator
DATA
STH
TP
POL
source driver
MCLK
DE
Hsync
Vsync
timing controller
STV
CPV
OE
gate driver
liquid crystal display panel

Fig.8

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2007070009 A1 **[0006]**
- US 2008284706 A1 **[0007]**
- US 2008170024 A1 **[0008]**
- US 2008291189 A1 **[0009]**

专利名称(译)	液晶显示面板极性反转驱动方法，驱动装置和显示装置		
公开(公告)号	EP3018651B1	公开(公告)日	2019-08-28
申请号	EP2013863702	申请日	2013-09-30
[标]申请(专利权)人(译)	京东方科技集团股份有限公司 合肥京东方光电科技有限公司		
申请(专利权)人(译)	京东方科技集团股份有限公司. 合肥京东方光电科技有限公司.		
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[标]发明人	HE JIAN		
发明人	HE, JIAN		
IPC分类号	G09G3/36		
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外部链接	Espacenet		

摘要(译)

本发明涉及液晶显示技术领域，尤其涉及一种液晶显示面板的极性反转驱动方法，驱动装置和显示装置。在该方法中，每个帧以相同的方式被划分为M个极性布置单元，并且每个2×M×N个帧形成一个反转驱动时段;在每个半反转驱动周期中，存在x，0 <x <= M×N，使得在第x帧和第（x + 1）帧之间，除了第一极性排列单元的极性相同之外，所有极性排列单元的极性相反;对于任何m，0 <= m <M，在第（x + m×N）帧和第（x + m×N + 1）帧之间，除了第（m + 1）极性的极性之外排列单元相同，所有极性排列单元的极性相反;每个其他帧的极性与其相邻的帧的极性相反;在彼此相邻的两个反转驱动周期中的两个中，相应帧的极性相反;在每个极性反转驱动周期中，每个子像素的整体极性不会偏转到一定极性，并且在极性反转驱动时液晶中发生液晶偏振或图像残留的问题避免。